Lecture 3: Labour Economics and Wage-Setting Theory

Spring 2019

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Literature: Chapter 5 Cahuc-Carcillo-Zylberberg: (pp 269-270, 280-287)
Chapter 3 Cahuc-Carcillo-Zylberberg: (pp 153-156, 169-174)
Chapter 6 Cahuc-Carcillo-Zylberberg: (pp 377-383)

Topics

- **The reservation wage**
- **Unemployment duration**
- **Compensating wage differentials**
- **Effort and social norms**

Eligibility and unemployment

- **Eligibility for unemployment insurance first after having had a job**
- **The reservation wage of ineligible unemployed falls when benefits increase: stronger incentive to get a job in order to qualify for benefits**

Two types of job seekers

1. **Those eligible for unemployment benefits**
2. **Those not eligible for unemployment benefits**

Behaviour of the non-eligible

V_{un} **= discounted value of unemployed non-eligible worker**
V_u **= discounted value of unemployed eligible worker**

Value of employment for an unemployed non-eligible worker:

$$rV_e(w) = w + q\,[V_u - V_e(w)] \qquad (13)$$

x_n **= reservation wage of non-eligible worker**

$$V_e(x_n) = V_{un} \qquad (13a)$$

Before we had (for eligible unemployed workers)

$$x = rV_u \qquad (13b)$$

Remember:

$\boldsymbol{rV_e(w) = w + q\,[V_u - V_e(w)]}$

$\boldsymbol{V_e(x_n) = V_{un}}$

$\boldsymbol{x = rV_u}$

From (13), (13a) and (13b):

$$rV_{un} = x_n + q\left[\frac{x}{r} - V_{un}\right]$$

$$V_{un}(r+q) = x_n + \frac{qx}{r}$$

$$rV_{un} = \frac{rx_n + qx}{r + q} \tag{14}$$

$$rV_{un} = z_n + \lambda \int_{x_n}^{\infty} \left[V_e(w) - V_{un}\right] dH(w) \tag{15}$$

Find $V_e(w) - V_{un}$.

From (13): $rV_e = w + q(V_u - V_e)$

$$V_e(r+q) = w + qV_u$$

Since $rV_u = x$ and $V_u = \dfrac{x}{r}$

$$V_e(r + q) = w + \frac{qx}{r}$$

$$V_e = \frac{w}{r+q} + \frac{qx}{r(r + q)}$$

From (14): $V_{un} = \dfrac{rx_n + qx}{r(r + q)}$

Hence:

$$V_e(w) - V_{un} = \frac{w}{r + q} + \frac{qx}{r(r+q)} - \frac{rx_n}{r(r + q)} - \frac{qx}{r(r + q)} =$$

$$= \frac{w}{r + q} - \frac{x_n}{r + q} \qquad \text{(A)}$$

Using (15), (14), and (A):

$$rV_{un} = \frac{rx_n + qx}{r+q} = z_n + \lambda \int_{x_n}^{\infty} \left[\frac{w}{r+q} - \frac{x_n}{r+q} \right] dH(w)$$

$$rx_n = (r + q)z_n - qx + \lambda \int_{x_n}^{\infty} (w - x_n) dH(w) \qquad \text{(B)}$$

$$\frac{\partial x_n}{\partial x} < 0, \quad \frac{\partial x}{\partial z} > 0$$

Hence: $\dfrac{\partial x_n}{\partial z} = \dfrac{\partial x_n}{\partial x} \bullet \dfrac{\partial x}{\partial z} < 0$

Interpretation

- **Higher unemployment benefit for eligible workers imply larger value of having a job (since this qualifies for the higher benefit in case of future unemployment)**
- **This creates an incentive to lower the reservation wage to get a job faster**

Define:

$$\Phi(x,\ x_n,\ z_n,\ r,\ \lambda,\ q)\ =\ rx_n\ -\ (r\ +\ q)z_n\ +\ qx$$

$$-\lambda\int_{x_n}^{\infty}(w\ -\ x_n)dH(w)\ =\ 0$$

$$\Phi_x dx + \Phi_n dx_n = 0$$

$$\frac{dx_n}{dx} = -\frac{\Phi_x}{\Phi_n}$$

$$\Phi_x = q > 0$$

$$\Phi_n = r - \lambda \int_{x_n}^{\infty} -H'(w)dw + \lambda(x_n - x_n)H'(x_n) =$$

$$= r + \lambda \int_{x_n}^{\infty} H'(w)dw > 0$$

$$\because \frac{dx_n}{dx} = -\frac{\overset{(+)}{\Phi_X}}{\underset{(+)}{\Phi_n}} < 0$$

Econometrics of duration models

- **Empirical studies of duration of unemployment**
  T = duration of unemployment (random variable)
  $F(t)$ = cumulative distribution function
  $f(t) = F'(t)$ = probability density function
  $F(t) = \Pr\{T < t\}$ = probability that T is smaller than t
- **Hazard function = instantaneous conditional probability of exiting from unemployment after having been unemployed for a period of length t**
- **If reservation wage is time-dependent, so that $x = x(t)$, the hazard is $\lambda[1 - H(x(t))]$**
- **Let $\varphi(\cdot)$ denote the hazard function**
- **If an individual has been unemployed for a period of length t, the conditional probability $\varphi(t)dt$ that the duration of unemployment is located within the interval $[t, t + dt]$ is:**

$$\varphi(t)dt = \Pr\{t \le T < t + dt \mid T \ge t\}$$

- **Use math for conditional probabilities:**

$$\Pr(A \cap B) = \Pr(B) \cdot \Pr(A \mid B)$$

$$\Pr(A \mid B) = \frac{\Pr(A \cap B)}{\Pr(B)}$$

- **Conditional probability of exiting from unemployment = Unconditional probability of exiting / Probability of having being unemployed at time t.**
- **Unconditional probability of exiting = $\Pr\{t \le T \le t + dt\} = f(t)dt$**
- **Probability of having being unemployed at time $t = \Pr\{T \ge t\} = 1 - \Pr\{T < t\} = 1 - F(t)$**

- Hence: $\varphi(t)dt \;=\; \dfrac{\Pr\left\{t \le T < t + dt\right\}}{\Pr\left\{T \ge t\right\}} = \dfrac{f(t)dt}{1-F(t)}$

$$\varphi(t) \;=\; \frac{f(t)}{\overline{F}(t)} \;\text{ with }\; \overline{F}(t) \;=\; 1-F(t)$$

- $\overline{F}(t)$ **is denoted the** **survival function** **= the probability that an unemployment spell lasts at least a period of length** ***t*****.**

Duration dependence

- **How does the probability of exiting from unemployment depend on time already spent in unemployment?**
- **$\varphi'(t) > 0$: positive duration dependence. Exit probability increases with duration of unemployment.**
- **$\varphi'(t) < 0$: negative duration dependence. Exit probability decreases with duration of unemployment.**
- **$\varphi(t) = \lambda[1\text{-}H(x(t))]$. Positive duration dependence if $x'(t) < 0$. Reservation wage falls over time if unemployment benefit is reduced over time.**
- **If $x'(t) = 0$ as in basic model there is no duration dependence.**

Estimation of hazard function

$\varphi(t, x, \theta)$

x = now a set of explanatory variables (unemployment benefits, unemployment rate, sex, age, education etc.)

θ = parameters

Proportional hazard model

$\varphi(t, x, \theta) = \rho(x, \theta_x)\varphi_0(t, \theta_0)$

Two sets of parameters θ_x and θ_0

φ_0 = baseline hazard (identical for all individuals)

Explanatory factors multiply the baseline hazard by the scale factor $\rho(x, \theta_x)$ independently of duration of unemployment t.

$\rho(x,\theta_x) = e^{x\,\theta x} \Rightarrow \psi(t,x,\theta) = e^{x\,\theta x}\,\psi_0(t,\theta_0)$

Hence:

$\ln \psi = x\theta_x \ln e + \ln \psi_0$

$\ln \psi = x\theta_x + \ln \psi_0$

$$\frac{\partial \ln\psi}{\partial x} = \theta_x$$

If *x* has been defined as (natural) logarithm, then θ_x gives the elasticity of the exit rate w.r.t. the explanatory variable.

Table 3.4

Commonly used distributions in duration models.

Distribution	$f(t)$	$\bar{F}(t)$	$\varphi(t)$	$\Phi(t)$
Exponential	$\gamma e^{-\gamma t}$	$e^{-\gamma t}$	γ	γt
Weibull	$\gamma \alpha t^{\alpha-1} e^{-\gamma t^{\alpha}}$	$e^{-\gamma t^{\alpha}}$	$\gamma \alpha t^{\alpha-1}$	γt^{α}
Log-logistic	$\frac{\gamma \alpha t^{\alpha-1}}{(1+\gamma t^{\alpha})^2}$	$\frac{1}{1+\gamma t^{\alpha}}$	$\frac{\gamma \alpha t^{\alpha-1}}{1+\gamma t^{\alpha}}$	$\ln(1+\gamma t^{\alpha})$

$$\overline{F}(t) = 1 - F(t)$$

$$F(t) = 1 - \overline{F}(t)$$

Exponential: No duration dependence

$$F(t) = 1 - \overline{F}(t) = 1 - e^{-\gamma t}$$

$$f(t) = \gamma e^{-\gamma t}$$

$$\psi(t) = \frac{f(t)}{\overline{F}(t)} = \frac{\gamma e^{-\gamma t}}{e^{-\gamma t}} = \gamma$$

Weibull: Duration dependence depends on $\alpha \gtrless 1$

Empirical studies

- **Studies of reservation wages**
  - **Can one believe survey studies?**
  - **Close to previous wages**
  - **Small elasticity with respect to unemployment benefit**

- **Studies of unemployment duration (exits from unemployment)**
  - **Small effects of unemployment benefit level: elasticity with respect to the replacement rate 0.4 – 1.6**
  - **Larger effect of potential (maximum) duration: increase by 1 week raises actual duration by 0.1 – 0.4 weeks**
  - **Some evidence on negative duration dependence**
  - **Increase in exit rates before benefit exhaustion**
  - **Effects of job search assistance and monitoring of search effort (sanctions)**
  - **But difficult to disentangle the effects of assistance and monitoring**

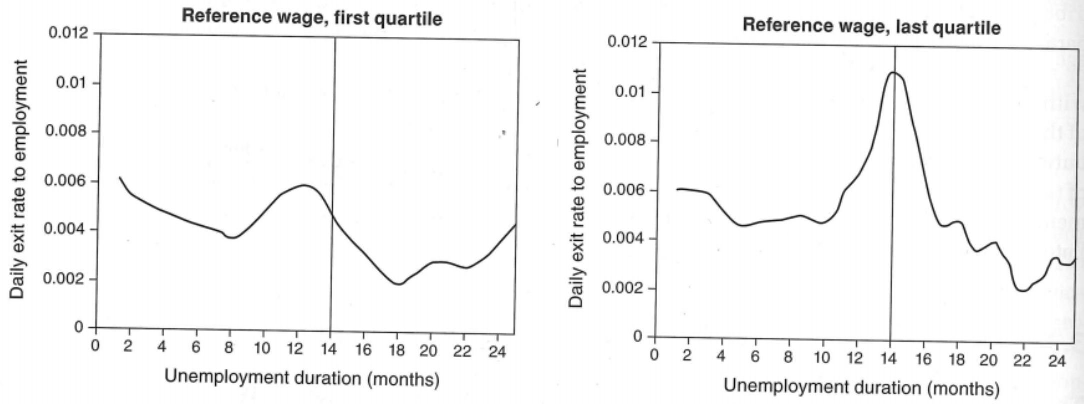
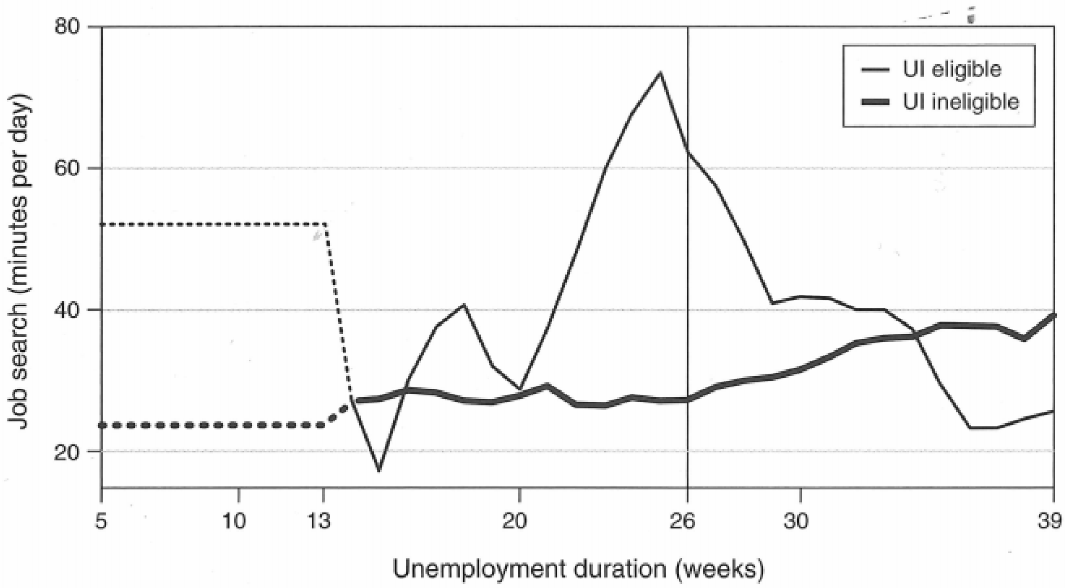


FIGURE 5.8

Exit rate from unemployment into employment and the end of entitlement to benefits. Period: 1986–1992. Population: individuals aged 25 and older. The reference wage corresponds to the average wage for the 12 months immediately preceding job loss.

Source: Dormont et al. (2001).



Note: The dotted lines refer to the average of time spent on job search before week 14.

FIGURE 5.1
Job search by unemployment duration in the United States over the period 2003–2006.

Source: Krueger and Mueller (2010, figure 3, p. 305).

<u>Study for Sweden by Carling, Holmlund and Vejsiu (2001)</u>

- **Natural experiment**
- **Benefit cut from 80 to 75 per cent of earlier wage in 1995**
- **Ceiling for benefits (in kronor)**
  – those above the ceiling receive less than 80 per cent
  – control group not receiving benefit cut
- **Difference-in-differences approach**

$$h(t) = h_0(t)\exp\{m[x, z(t); \mathbf{\Omega}] + \delta D_t^{96} + \gamma D^{\mathrm{T}} + \lambda D^{\mathrm{T}} D_t^{96}\}$$

- **Estimated elasticity 1.6**
- **Later study of benefit hikes showed reduction of job finding rate for men but increase for women.**

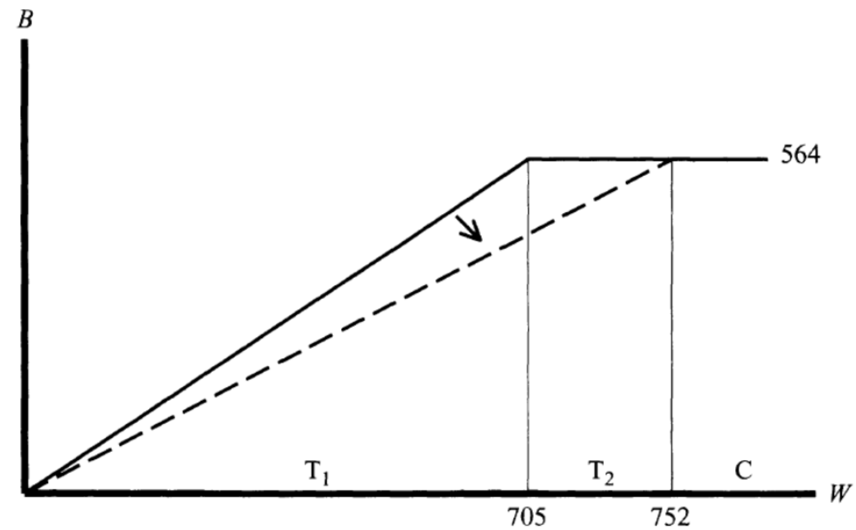


Fig. 1. *Unemployment Benefits in Sweden in the mid-1990s*
Note: The solid (dashed) line depicts the replacement rate before (after) 1 January 1996

TABLE 5.8
Reservation wage ratio by duration of unemployment.

All durations	< 5 weeks	5–9 weeks	10–14	15–19	20–24	25–49	> 50
0.99	1.04	1.02	1.01	1.00	1.06	0.95	0.94

Source: Krueger and Mueller (2011, table 4.1).

TABLE 5.9
Elasticities of the reservation wages with respect to the income of unemployed persons.

Authors	Data	Elasticities
Lynch (1983)	UK (youth)	0.08 – 0.11
Holzer (1986)	US (youth)	0.018 – 0.049
van den Berg (1990)	Netherlands (30–55 years)	0.04 – 0.09

Source: Devine and Kiefer (1991, table 4.2, p. 75).

Compensating wage differentials

- **Wage differentials may depend on differences in workers' skills (theory of human capital)**
- **But they can also depend on differences in working conditions**
  - Adam Smith: compensating wage differentials
  - Harvey Rosen: hedonic theory of wages
- **Important to distinguish between**
  (1) conditions of work (differ between jobs)
  (2) disutility of work (differs among individuals)

<u>Perfect competition with jobs of equal difficulty</u>

- **Transparency: perfect information**
- **Free entry: agents may enter and exit the market without costs**
- **One unit of labour produces y**
- **Each worker supplies one unit of labour and receives the wage w**

Utility function: $u(R, e, \theta)$

R is income
R = w if the worker is employed
R = 0 if the worker does not work

e is the effort (disagreeability) of a job
e = 1 on a job
e = 0 if no job

$\theta \geq 0$ is the disutility (opportunity cost) of work for an individual

All jobs have the same disagreeability, but individuals' disutility of work differs.

G(θ) is the cumulative distribution function of the parameter θ.

$u(R, e, \theta) = R - e\theta$

Profit of a firm

$\pi = y - w$ for each job

$$L^d = \begin{cases} +\infty & \text{if } y > w \\ [0, +\infty] & \text{if } y = w \\ 0 & \text{if } y < w \end{cases}$$

Utility of a worker

$u = w - \theta e = w - \theta$ if working (since $e = 1$)
$u = 0$ if not working

- **Hence, only individuals with $\theta < w$ decide to work**
- **Normalise labour supply to 1**
- **Then labour supply is $G(w)$**

Labour market equilibrium

- **w = y; labour supply = $G(y)$**
- **Zero profits for firms**
- **Only individuals for which $\theta \leq y$ choose to work**
- **The allocation is thus efficient**

Decision problem of a social planner

$$\underset{\theta}{\text{Max}} \int_0^\theta (y - x)dG(x) = \int_0^\theta (y - x)G'(x)dx$$

$$\text{FOC}: 1(y - \theta)G'(\theta) = 0$$

$$\theta = y$$

The competitive equilibrium is efficient!

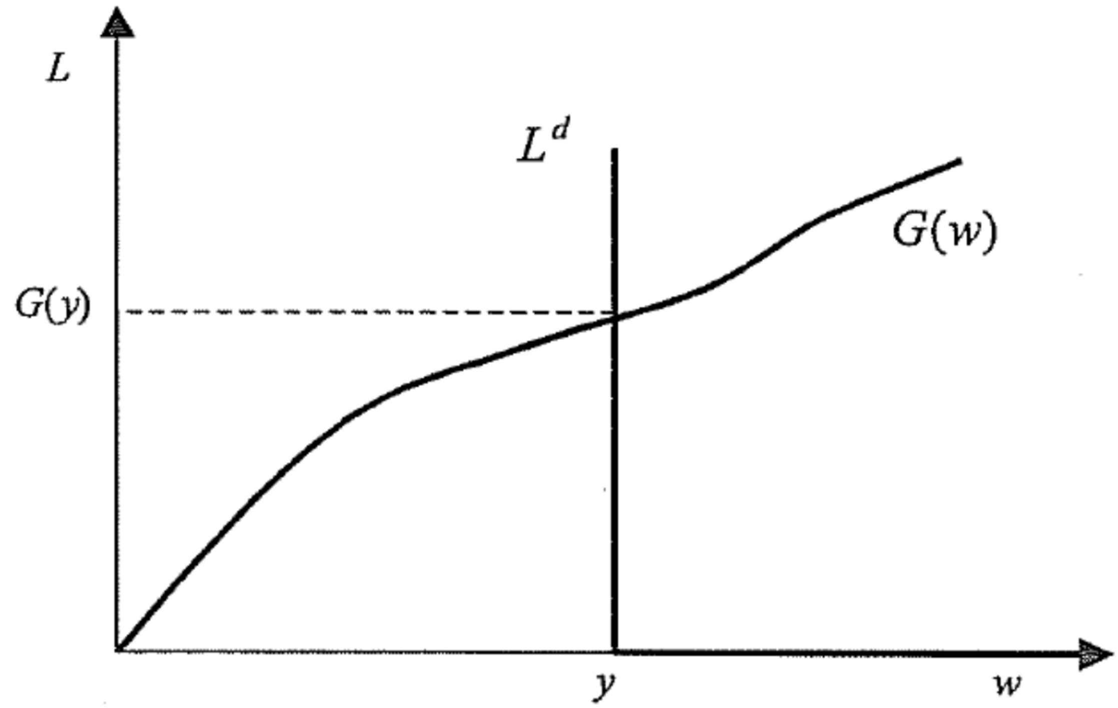


FIGURE 5.1
Market equilibrium with perfect competition.

Compensating wage differentials when jobs are heterogeneous

A continuum of jobs, each requiring a different level of effort $e > 0$

$y = f(e)$ **with** $f'(e) > 0$, $f''(e) < 0$ **and** $f(0) = 0$

$u = u(R, e, \theta) = R - e\theta$

$e > 0$ **on a job,** $e = 0$ **if no job**

Free entry assumption: profits are zero for every type of job

Hence $w(e) = f(e)$

Decision problem of a worker

Find a job with effort e **that gives the largest utility**

$$\max_{e} \; u[f(e), e, \theta] = f(e) - e\theta$$

s.t. participation constraint: $u(w, e, \theta) \geq u(0, 0, \theta) = 0$

FOC

$$f'(e) = \theta \Leftrightarrow e = e(\overset{(-)}{\theta}) \quad \text{if } f[e(\theta)] - \theta[e(\theta)] \geq 0$$

$$e = 0 \quad \text{if } f[e(\theta)] - \theta[e(\theta)] < 0$$

- **Choose a job in which the marginal return on effort is equal to the disutility of work**
- **Optimal effort is decreasing with the disutility of work**
- **Since** $w[e(\theta)] = f[e(\theta)]$**, the wage increases with effort and workers with less aversion to effort obtain a higher wage (a compensating wage differential).**

Equation of an indifference curve

$$u = u(R, e, \theta) = R - e\theta = w - e\theta = \overline{u}$$

$$dw - \theta de = 0$$

$$\frac{dw}{de} = \theta \text{ is the slope of an indifference curve}$$

- **The higher the disutility of effort, the steeper is the indifference curve**
- **Choose a level of effort such that an indifference curve is tangent to "production function" (its slope is equal to θ)**
- **Individuals with a strong aversion to effort choose low-effort jobs with low wages**
- **Individuals whose aversion to effort is too large, i.e. with $\theta > f[e(\theta)] / e(\theta)$, choose not to work. This is the case if $\theta > f'(0)$**

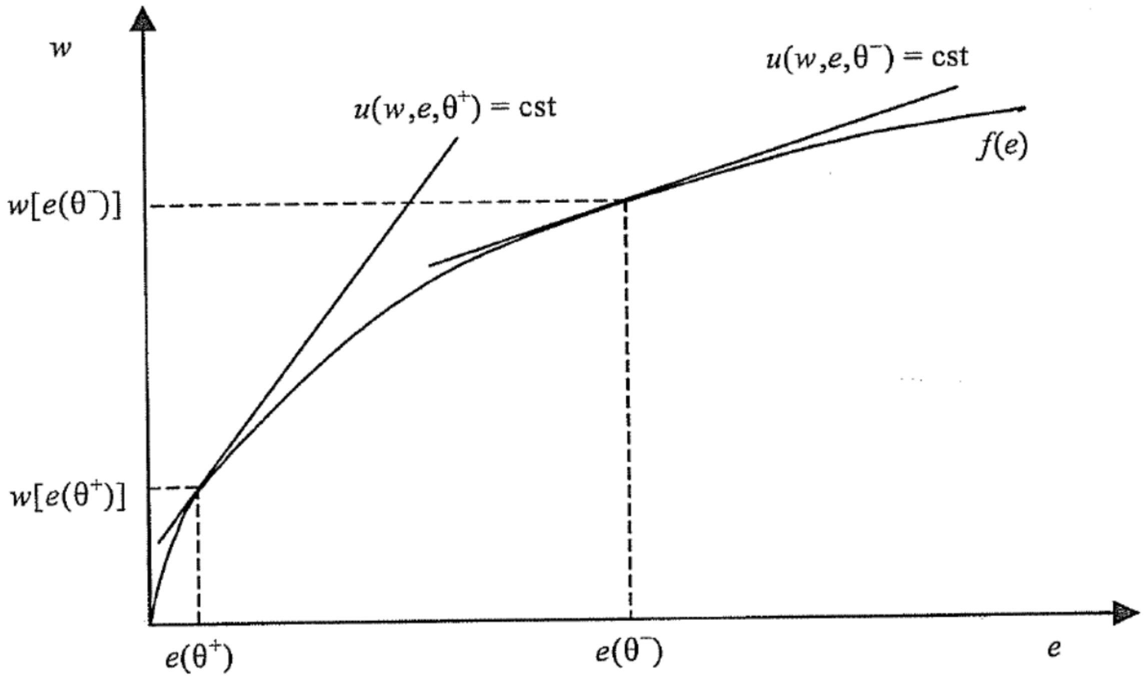


Figure 5.2
The hedonic theory of wages.

- **Again an efficient allocation**
- **For each worker the difference between the wage and the disutility is maximised**

<u>Problem of a social planner</u>

$$\underset{\theta^*, e(\theta)}{\text{Max}} \int_0^{\theta^*} \{f[e(\theta)] - \theta e(\theta)\} dG(\theta)$$

where θ* is the threshold beyond which individuals no longer participate.

<u>FOC</u>

$$1 \cdot \left\{ f\left[e(\theta^*)\right] - \theta^* e(\theta^*) \right\} G'(\theta^*) = 0$$

$$f'\left[e(\theta)\right] - \theta = 0$$

$$f\left[e(\theta^*)\right] = \theta^* e(\theta^*)$$

$$f'\left[e(\theta)\right] = \theta \qquad \theta \in 0, \theta^*$$

- ***e*(θ*) = 0 by definition and so θ* = *f′*(0)**
- **Same allocation as in competitive equilibrium**
  - ***f′*[*e*(θ)] = θ**
  - **No work if θ > θ* = *f′*(0)**

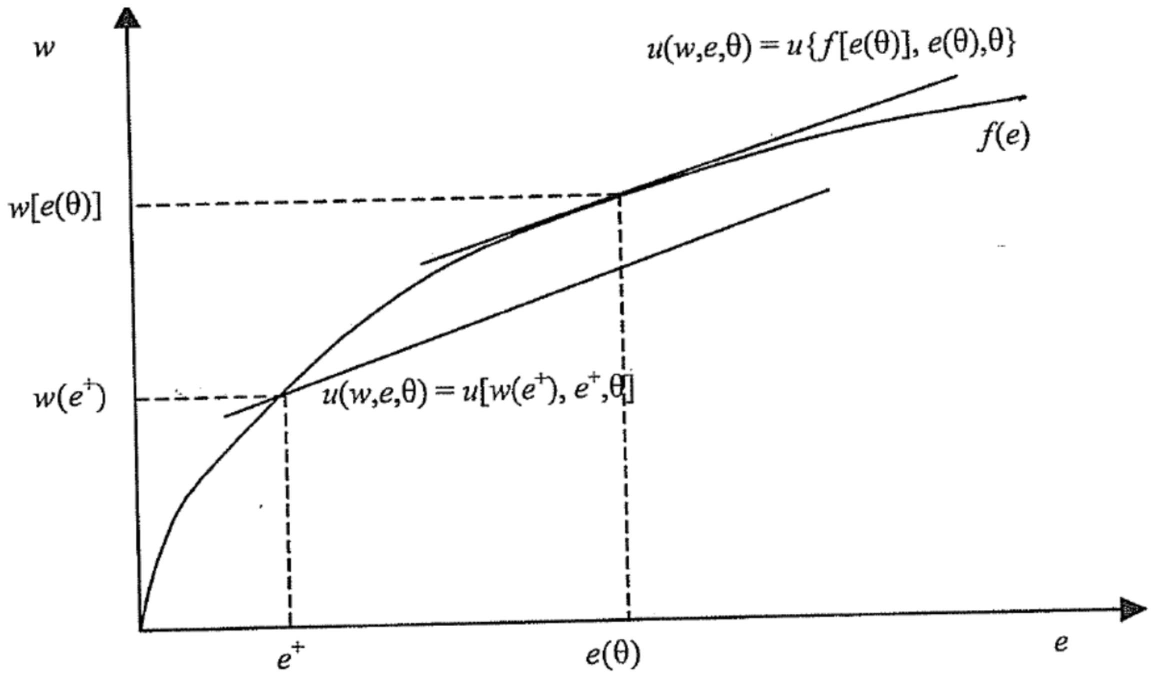


FIGURE 5.3
The impact of a legal constraint on accident risk.

- **Regulation to prohibit "dangerous jobs" (modelled as requiring effort above a certain level) is undesirable**

  - welfare loss for everyone with $e > e^+$ if e^+ is maximum effort level allowed

  - lower wage, lower effort and lower utility for these individuals

- **But this is based on the assumption of perfect competition**

<u>A model of social norms</u>

- **Fair wages**
- **Gift exchange (Akerlof 1982)**
- **Many employees exceed work standards**
- **Employers pay a wage above "the reference wage"**

<u>Assumptions</u>

Size of labour force is normalised to 1

ϖ = average wage

Utility of a worker is: $u = u(R, e, \varpi) = R[1 + \beta(e/\varpi] - (e^2/2)$ with $\beta \geq 0$

e = level of effort if working

e = 0 if not working

R = income

$R = w$ = the wage if working

$R = \theta$ = the opportunity cost of working otherwise

θ = characterised by the cumulative distribution function $G(\cdot)$.

<u>Interpretation</u>: The worker takes more satisfaction from her effort if the relative wage w/ϖ is high.

Output $f(e) = e$

Free entry requires zero profits, i.e. $w = f(e) = e$

<u>No fairness considerations:</u> **β = 0**

$$u = R\left[1 + \beta\frac{e}{\omega}\right] - \frac{e^2}{2} = R - \frac{e^2}{2} = e - \frac{e^2}{2}$$

$$\underset{e}{\text{Max}}\ e - \frac{e^2}{2}$$

$$1 - 2e/2 = 0$$

$$e = 1$$

The utility of a worker is then:

$$u = e - \frac{e^2}{2} = 1 - \frac{1}{2} = \frac{1}{2}$$

All individuals with $\theta < \frac{1}{2}$ choose to work.

Total employment is $G\left(\frac{1}{2}\right)$

Fairness matters: $\beta > 0$

Each worker takes the average wage ω as given when maximising utility

$$\max_{e} \quad e\left[1 + \beta\frac{e}{\omega}\right] - \frac{e^{2}}{2}$$

FOC:

$$1 + \frac{2\beta e}{\omega} - e = 0$$

$$e = \left[1 - \frac{2\beta}{\omega}\right]^{-1}$$

- **This holds for every worker**
- **Hence every worker chooses the same effort level**
- **Hence the individual effort level must equal the average effort level (a symmetric equilibrium), i.e. $e = \omega$**

This gives:

$$e = 1 + 2\beta = \omega$$

- **Social norms influence productivity (effort)**
- **The effort level with social norms is higher than without them**

$$e_{\beta > 0} = 1 + 2\beta > e_{\beta = 0} = 1$$

- **Utility of an employed worker is**

$$e + \beta e - \frac{e^2}{2} = e(1 + \beta) - \frac{e^2}{2} =$$

$$= (1 + 2\beta)(1 + \beta) - \frac{(1 + 2\beta)^2}{2} = \frac{1}{2} + \beta$$

- **Employment rises to**

$$G\left[\beta + \frac{1}{2}\right]$$

- **So, here social norms increase effort, the wage, utility and employment**
- **But the employment result is not general**

With social norms, the competitive equilibrium is no longer efficient.

<u>Social optimum</u>

- **Choose effort such that utility of an individual worker is maximised under the assumption that $e = \omega$**
- **Since all workers supply the same effort level, this maximises the sum of utilities**

$$\max_{e} \quad e\left[1 + \beta \frac{e}{\omega}\right] - \frac{e^2}{2} \qquad \text{s.t.} \quad e = \omega$$

$$\max_{e} \quad e[1 + \beta] - \frac{e^2}{2}$$

$$(1 + \beta) - e = 0$$

$$e = 1 + \beta$$

- **The socially optimal effort level increases in the degree of consideration of fairness but it is lower than the competitive level.**
- **The explanation is that effort on the part of an individual has a negative externality, which is internalised by a social planner.**
- **Fairness considerations are being given larger weight in economic theory.**
- **No general consensus on how to introduce them.**
- **Tendency to regard fairness assumptions as very much *ad hoc*.**
- **But neglecting them as in traditional theory is just as *ad hoc* – we are just more used to them.**