Lecture 3: Labour economics

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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:

$$rV_e(w) = w + q \ [V_u - V_e(w)] \tag{13}$$

x_n = reservation wage of non-eligible worker

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

Before we had (for eligible unemployed workers)

$$x = rV_u$$

From (13)

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

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

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

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

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

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

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

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

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

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

Hence:

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

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

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

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

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

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

$$\text{Hence:} \quad \frac{\partial x_n}{\partial z} = \frac{\partial x_n}{\partial x} \cdot \frac{\partial x}{\partial z} < 0$$

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:

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

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

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

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

$$\Phi_x \ = \ q \ > \ 0$$

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

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

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

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 employed 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:**

$$\varphi(t)dt = \Pr\{t \leq T < t + dt \mid T \geq t\}$$

  - **Use math for conditional probabilities:**

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

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

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

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

- $\overline{F}(t)$ **is denoted the <u>survival function</u> = 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.)**

$\theta =$ **parameters**

Proportional hazard model

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

Two sets of parameters ρ_x and ρ_0

$\varphi_0 =$ **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.

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	$\gamma a t^{a-1} e^{-\gamma t^a}$	$e^{-\gamma t^a}$	$\gamma a t^{a-1}$	γt^a
Log-logistic	$\dfrac{\gamma a t^{a-1}}{(1+\gamma t^a)^2}$	$\dfrac{1}{1+\gamma t^a}$	$\dfrac{\gamma a t^{a-1}}{1+\gamma t^a}$	$\ln(1+\gamma t^a)$

Common formulation: Proportional hazard model

$$\rho(x, \theta_x) = e^{x\theta_x}$$

Hence:

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

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 3.2. **Net replacement rates and unemployment insurance benefit duration in 26 OECD countries, 2004**

	Initial net replacement rate[a] (percentage of net earnings in work)	Unemployment insurance benefit duration[b, c] (months, equivalent initial rate)	Average of net replacement rates over 60 months of unemployment[d] (percentage of net earnings in work)
Asia	54	8	8
Japan	62	8	48 (+2)
Korea	47	7	42
English-speaking, non-Europe	54	4	4
Australia	45	0	46
New Zealand	56	0	54
Canada	63	9	48
United States	54	6	36 (−6)
English-speaking Europe	51	11	11
Ireland	49	15	64
United Kingdom	54	6	53 (−1)
Nordic Europe	71	34	34
Denmark	70	48	70
Finland	70	23	65 (−9)
Norway	68	36	58
Sweden	75	28	63
Central western Europe	70	18	19
Austria	63	9	57 (−2)
Belgium	61	No limit	61
France	75	23	57 (+4)
Germany	69	12	66 (−3)
Netherlands	74	24	66
Switzerland	77	24	69
Southern Europe	65	16	16
Greece	55	12	35
Italy	54	6	22 (+2)
Portugal	83	24	68
Spain	67	21	49
Eastern Europe	55	9	9
Czech Republic	56	5	53 (−5)
Hungary	49	9	39
Poland	59	12	54
Slovak Republic	56	8	40

a) Initial net replacement rate is an average of cases of a single person and one-earner married couple, an average of cases with no children and with two children, and an average of cases with previous earnings in work 67% of average production worker (APW) level, 100% of APW level and 150% of APW level. Typical-case calculations relate to a 40-year-old worker who has been making contributions continuously since age 18. Net income out of work includes means-tested benefits (housing benefits are calculated assuming housing costs are 20% of APW earnings) where relevant but not non-categorical social assistance benefits. Taxes payable are determined in relation to annualised benefit values (i.e. monthly values multiplied by 12), even if the maximum benefit duration is shorter than 12 months. See the source for further details.

b) Duration is shown as zero for Australia and New Zealand since they do not operate unemployment insurance schemes. The net replacement rates in the first column for these two countries reflect means-tested unemployment benefits which are not subject to a time limit.

c) Months equivalent initial rate for the Czech Republic, the Slovak Republic and Spain where the benefit level declines during the UI period (e.g. for Spain, where the nominal replacement rate declines from 70% to 60% after six months, the months equivalent initial rate is calculated as six months plus 6/7ths of 18 months).

d) As note a) except that the net replacement rates are averaged over five years of unemployment, the three previous earnings levels considered are 67%, 100% and 150% of the average wage (all workers), and non-categorical social assistance benefits are included in out-of-work net income. Values in brackets are percentage point changes between 1995 and 2004, which are only available for a small number of countries. Data for Korea and New Zealand correspond to 2001.

Source: OECD database on Benefits and Wages.   Statlink: http://dx.doi.org/10.1787/182506528237

<u>Empirical studies</u>

- **Studies of reservation wages**
  - **Can one believe survey answers?**

- **Studies of duration (exits from unemployment)**

  - **small effects of unemployment benefits**

  - **some evidence of negative duration dependence**

  - **larger exit rates before benefit exhaustion**

  - **large probabilities of accepting job offers**

  - **effects of job search assistance and monitoring of search effort (sanctions)**

  - **difficult to disentangle assistance/control**

Table 3.7

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

Authors	Data	Elasticities
Lynch (1983)	U.K. (youth)	0.08–0.11
Holzer (1986)	U.S. (youth)	0.018–0.049
van den Berg (1990)	Netherlands (30–55 yr)	0.04–0.09

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

Table 3.9

Some empirical studies using duration models.

Authors	Data	Elasticity of unemployment benefits	Elasticity of duration of benefits
Lancaster (1979)	U.K. (not specified)	0.43–0.6	
Narendranathan et al. (1985)	U.K. (men)	0.08–0.65	
Moffit (1985)	U.S. (men)		0.16–0.36
Meyer (1990)	U.S. (men)		0.60–0.88
Katz and Meyer (1990)	U.S. (men)	0.8–0.9 (youth)	0.36–0.48

Source: Devine and Kiefer (1991, table 5.2).

Reference wage in the bottom quartile

Reference wage in the top quartile
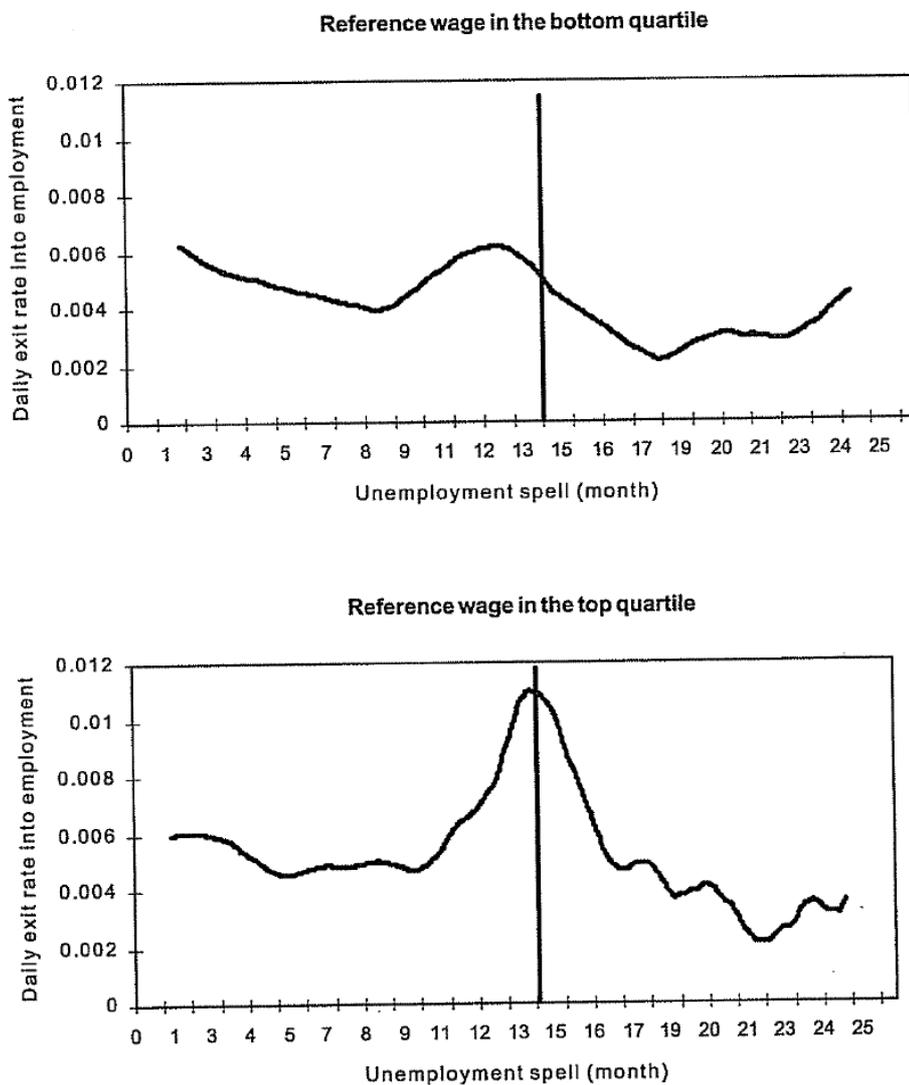
FIGURE 3.2

Exit rate from unemployment and the end of entitlement to benefits for the period 1986–1992, for individuals aged 25 and over. The reference wage corresponds to the average wage for the twelve months immediately preceding job loss.

Source: Dormont et al. (2001).

Table 3.10

The probability of accepting an offer.

Authors	Data	Probability
Devine (1988)	U.S.	0.91–1.0
Wolpin (1987)	U.S.	0.88
van den Berg (1990)	Netherlands	0.89–1.0

Source: Devine and Kiefer (1991, table 5.3, p. 138, and table 6.4, p. 174).

<u>Compensating wage differentials</u>

- **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.

$G(\cdot)$ 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 $\theta < y$ choose to work**
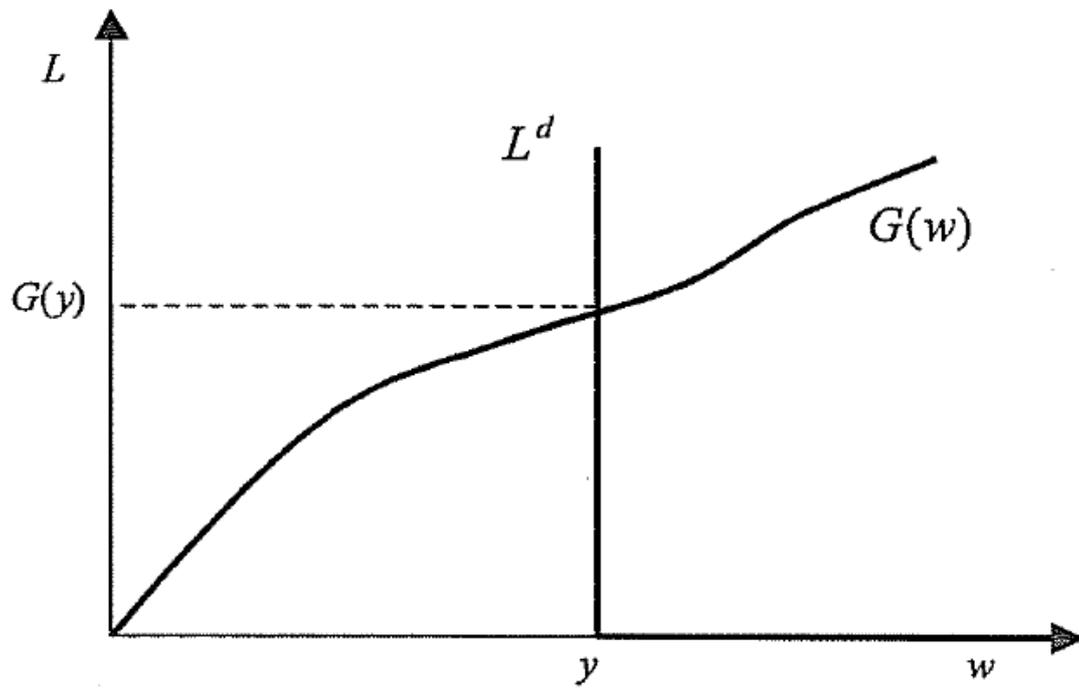- **The allocation is thus efficient**

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

$$\underset{e}{\text{Max}} \ u[f(e), e, \theta] = f(e) - e\theta$$

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

FOC

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

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

- **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 $\theta > f'(0)$**
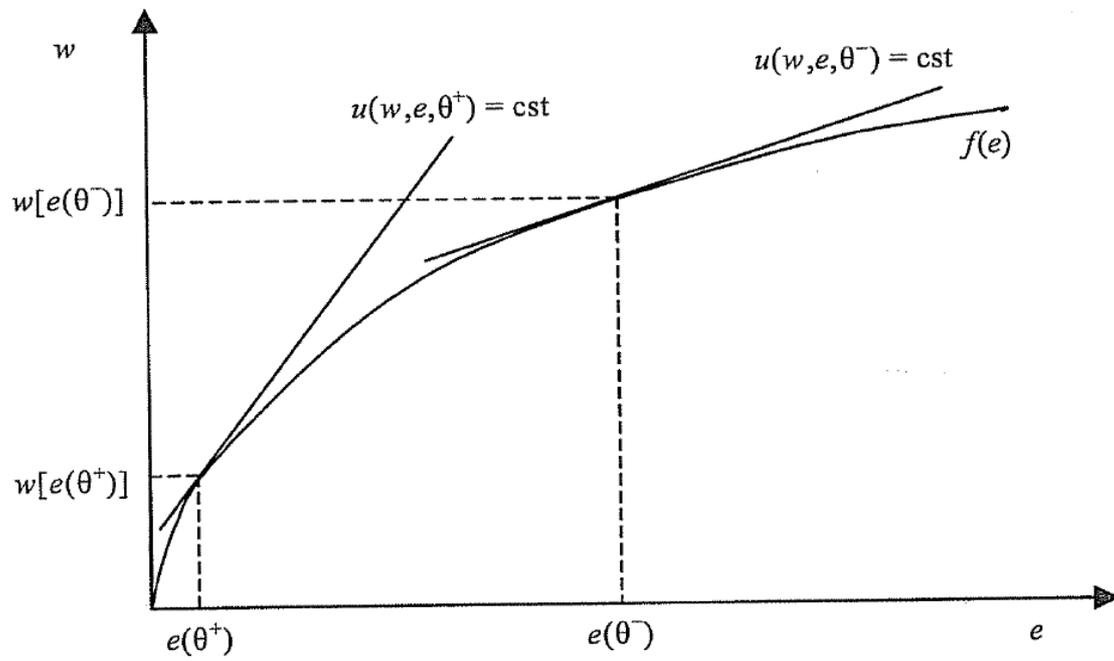
FIGURE 5.2
The hedonic theory of wages.

- **Again an efficient allocation**

- **For each worker the difference between the wage and the disutility is maximised**

Problem of a social planner

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

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

FOC

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

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

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

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

Hence:

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

$$\frac{f\left[e(\theta^*)\right]}{e(\theta^*)} = f'\left[e(\theta^*)\right]$$

- $e(\theta^*) = 0$ by definition and so $\theta^* = f'(0)$

- **Same allocation as in competitive equilibrium**
    - $f'[e(\theta)] = \theta$
    - **No work if $\theta > \theta^* = \theta'(0)$**
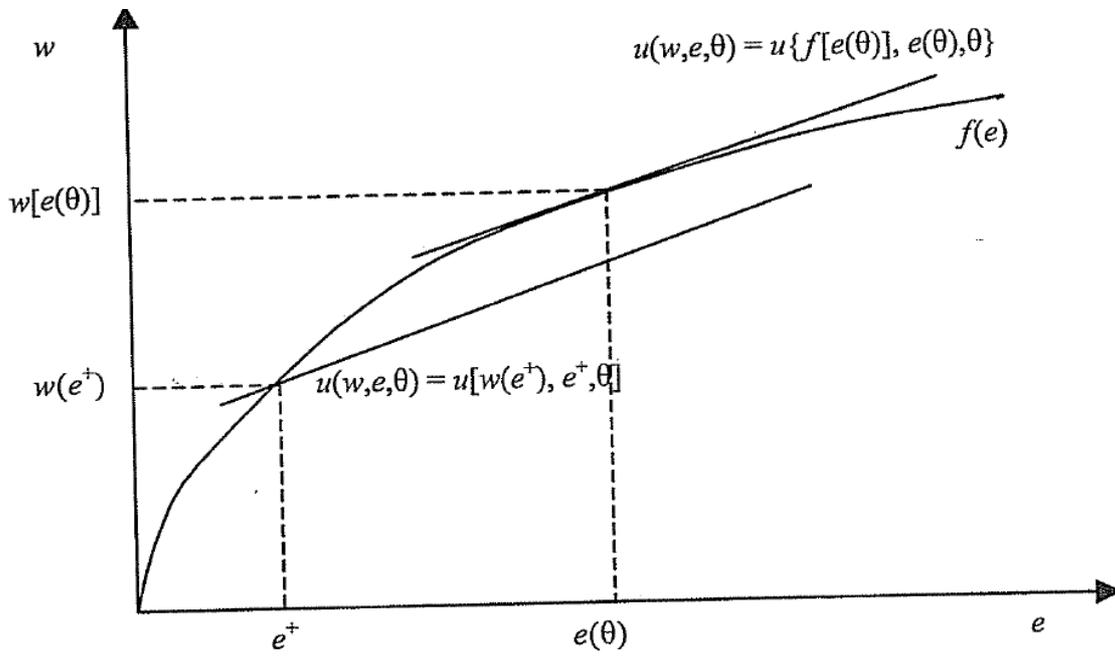
FIGURE 5.3
The impact of a legal constraint on accident risk.

- **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**

A model of social norms

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

Assumptions
Size of labour force is normalised to 1

ω = **average wage**

Utility of a worker is: $u = u(R, e, \omega) = R[1 + \beta(e/\omega)] - (e^2/2)$ **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(·).**

Interpretation: The worker takes more satisfaction from her effort if the relative wage w/ω is high.

Output $f(e) = e$

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

No fairness considerations: 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 $\theta < \dfrac{1}{2}$ choose to work.

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

Fairness matters: $\beta > 0$

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

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

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

- **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.

Social optimum

- **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**

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

$$\underset{e}{\text{Max}} \quad e\left[1 + \beta\right] - \frac{e^2}{2}$$

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

$$e = 1 + \beta$$

- **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.**