

Economics of Information

LECTURE 5

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Equilibrium unemployment

involuntary unemployment

“a situation where an unemployed worker is willing to work for less than the wage received by an equally skilled employed, yet no job offers are forthcoming” [Shapiro and Stiglitz (1984), p. 433]

- involuntary unemployment is a persistent feature of the labour market
- why don't wages fall to clear the market?

Shapiro and Stiglitz (1984)

- *equilibrium* involuntary unemployment can be explained by the information structure of employer/employee relationship
- in particular, by the inability of the employer to *costlessly* observe workers' on-the-job effort



conventional competitive paradigm

- all workers receive the market wage
- no unemployment
- a worker caught shirking is immediately fired
- but is also immediately rehired by another employer for the same wage
- the worker pays no penalty for her misdemeanor
- with full employment and imperfect monitoring all workers shirk



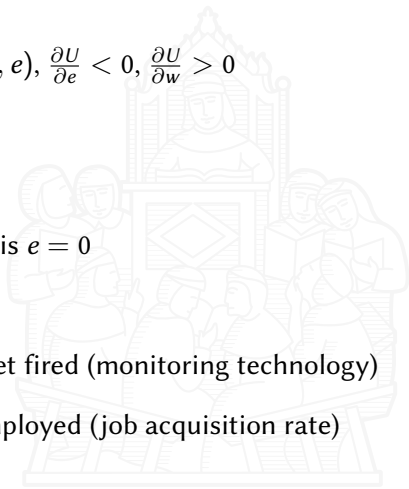
Shapiro and Stiglitz (1984)

- to induce the worker to '*behave*' the firm offers an higher wage
- a worker caught shirking now pays a penalty
- if a firm is better off raising the wage, then all firms follow
- but then with no wage differential the penalty disappears
- however raising wages decreases labour demand
- unemployment results
- if a worker is fired, she will not be rehired immediately
- in equilibrium, unemployment is large enough that it pays workers to work, rather than taking the risk of being caught shirking
- "*equilibrium unemployment as a worker discipline device*"



The model

- N identical workers (being fired carries no stigma): $U(w, e)$, $\frac{\partial U}{\partial e} < 0$, $\frac{\partial U}{\partial w} > 0$
- $U(\cdot)$ is separable and risk-neutral, say $U(w, e) = w - e$
- effort has 2 levels (discrete choice): either 0 or $e > 0$
- when unemployed, worker receives benefit $\bar{w}$ and effort is $e = 0$
- b : exogenous probability of losing job due to relocation
- q : exogenous probability of being caught shirking and get fired (monitoring technology)
- α : endogenous probability of acquiring a job while unemployed (job acquisition rate)



The model (cont'd)

- workers maximise expected present discounted value of utility with $r > 0$

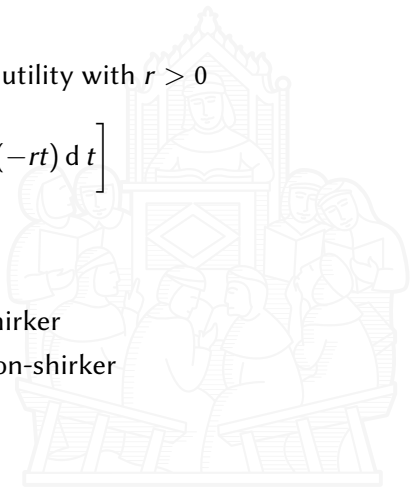
$$\max_e E \left[\int_0^\infty u(w(t), e(t)) \exp(-rt) dt \right]$$

- model in continuous time but discrete choice over e
- define

V_E^S : expected lifetime utility of an employed shirker

V_E^N : expected lifetime utility of an employed non-shirker

V_u : expected lifetime utility of an unemployed



The model (cont'd)

- take V_u as given; consider a short interval $[0, t]$ and the approximation $\exp(-rt) \approx 1 - rt$

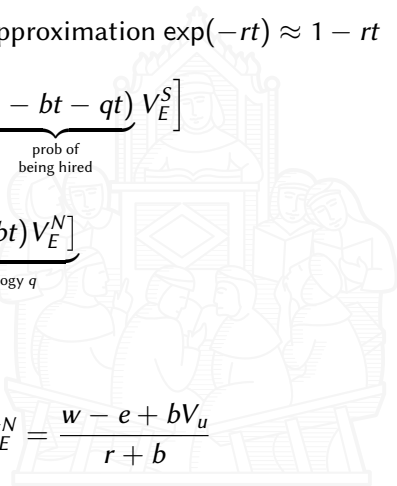
$$V_E^S = wt + \underbrace{(1 - rt)}_{\text{discount factor}} \left[\underbrace{(bt + qt)}_{\text{prob. of losing job}} V_u + \underbrace{(1 - bt - qt)}_{\text{prob of being hired}} V_E^S \right]$$

$$V_E^N = \underbrace{wt - et}_{\text{effort reduces utility}} + (1 - rt) \underbrace{[btV_u + (1 - bt)V_E^N]}_{\text{monitoring technology } q \text{ plays no role}}$$

- in the limit (hint: use the de l'Hôpital rule)

$$\lim_{t \rightarrow 0} V_E^S = \frac{w + (b + q)V_u}{r + b + q}$$

$$\lim_{t \rightarrow 0} V_E^N = \frac{w - e + bV_u}{r + b}$$



The model (cont'd)

- no-shirking condition is $V_E^N \geq V_E^S$

$$\frac{w - e + bV_u}{r + b} \geq \frac{w + (b + q)V_u}{r + b + q}$$

$$w \geq rV_u + \frac{e(r + b + q)}{q} \equiv \hat{w} \quad (\text{NSC})$$

- if firm pays a wage high enough, the worker will not shirk

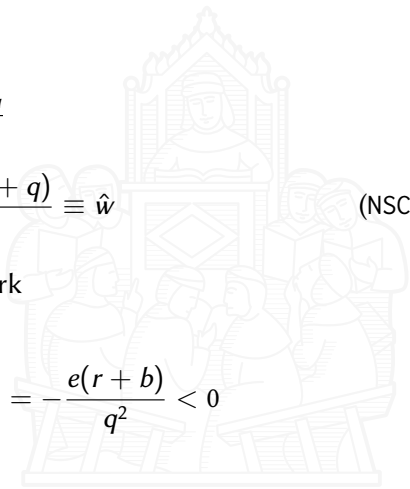
$$\frac{\partial \hat{w}}{\partial e} > 0$$

$$\frac{\partial \hat{w}}{\partial V_u} > 0$$

$$\frac{\partial \hat{w}}{\partial b} > 0$$

$$\frac{\partial \hat{w}}{\partial r} > 0$$

$$\frac{\partial \hat{w}}{\partial q} = -\frac{e(r + b)}{q^2} < 0$$

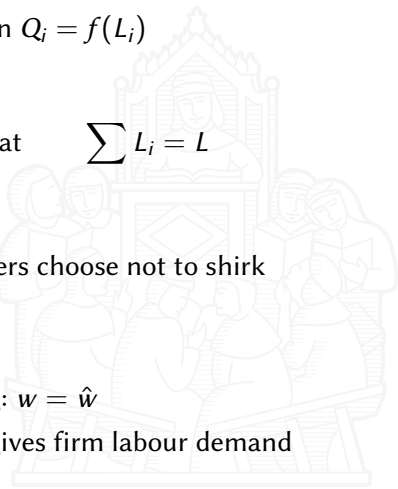


The model (cont'd)

- there are M identical firms, each with production function $Q_i = f(L_i)$
- aggregate production function:

$$Q = F(L) \equiv \max_{L_i} \sum f_i(L_i) \quad \text{such that} \quad \sum L_i = L$$

- full-employment is efficient: $F'(N) > e$
- firms compete in offering wage contracts such that workers choose not to shirk
- wage contract includes values of w and $\bar{w}$
- it is optimal for a firm to offer the minimum $\bar{w}$
- a firm wants to pay minimum wage ensuring no-shirking: $w = \hat{w}$
- if $\bar{w} = 0$, the condition *marginal product = marginal cost* gives firm labour demand $f'(L_i) = \hat{w}$, and at the aggregate level: $F'(L) = \hat{w}$



market equilibrium

- if wage is very high, the worker values her job because of
 - 1 the high wage itself
 - 2 the low level of employment (low demand for labour), implying being unemployed for a long time if she loses her job

⇒ firms can reduce the wage without tempting workers to shirk
- if wage is very low, the worker is tempted to shirk because of
 - 1 working is only moderately preferred to unemployment
 - 2 the high level of employment (large demand for labour), implying being unemployed for a short time if she loses her job

⇒ firms can raise the wage to satisfy the NSC
- at the equilibrium each firm, taking as given wage and employment levels at other firms, finds it optimal to offer the going wage, rather than a different wage

asset equations

- we can rewrite utilities as

$$rV_E^S = w + (b + q)(V_u - V_E^S)$$

$$rV_E^N = w - e + b(V_u - V_E^N)$$

$$rV_u = \bar{w} + a(V_E - V_u)$$

- *interest rate times asset value equals flow benefits (dividends) plus expected capital gains/losses*
- V_E is the expected utility of a generic employed worker

The model (cont'd)

- in equilibrium $V_E = V_E^N$
- substitute V_E^N definition in V_u 's asset equation

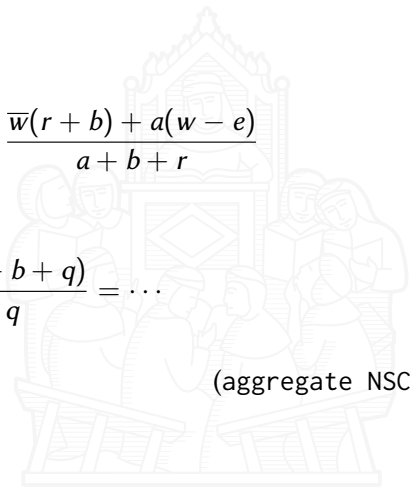
$$rV_u = \bar{w} + a \left[\frac{w - e + bV_u}{r + b} - V_u \right] = \dots = \frac{\bar{w}(r + b) + a(w - e)}{a + b + r}$$

- substitute rV_u in (NSC) to get *aggregate* NSC

$$w \geq \frac{\bar{w}(r + b) + a(w - e)}{a + b + r} + \frac{e(r + b + q)}{q} = \dots$$

$$w \geq \bar{w} + e + \frac{e(a + b + r)}{q} \equiv \hat{w} \quad (\text{aggregate NSC})$$

- it holds: $\frac{\partial \hat{w}}{\partial \bar{w}} > 0$ $\frac{\partial \hat{w}}{\partial a} > 0$



The model (cont'd)

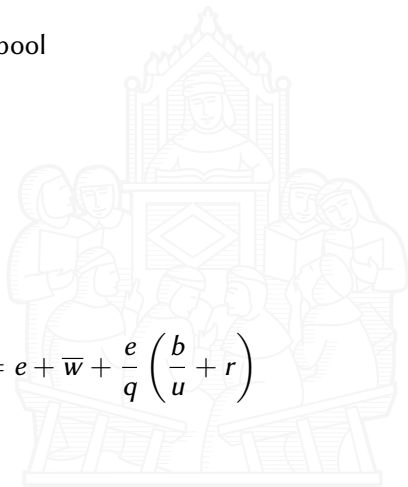
- in a steady state, bL is the flow *into* the unemployment pool
- $a(N - L)$ is the flow *out* of the unemployment pool
- in equilibrium it must be $bL = a(N - L)$ or

$$a = \frac{bL}{N - L}$$

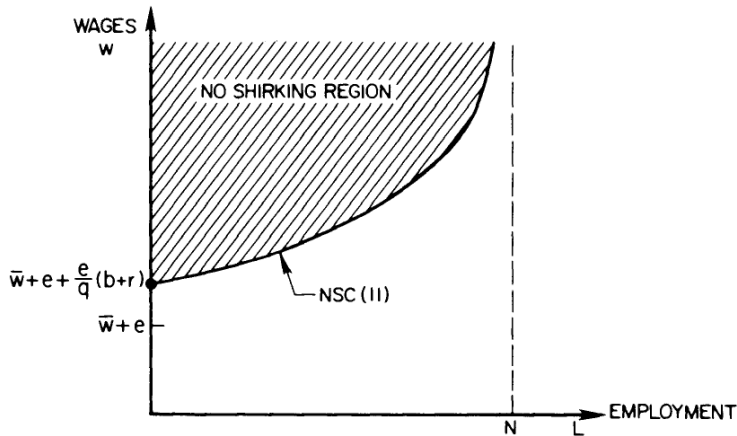
- substitute a into (aggregate NSC)

$$w \geq \bar{w} + e + \frac{e}{q} \left(\frac{bL}{N - L} + b + r \right) = \dots = e + \bar{w} + \frac{e}{q} \left(\frac{b}{u} + r \right)$$

where $u = \frac{N-L}{N}$ is the unemployment level



The model (cont'd)



Source: Shapiro and Stiglitz (1984, p. 438, fig. 1)



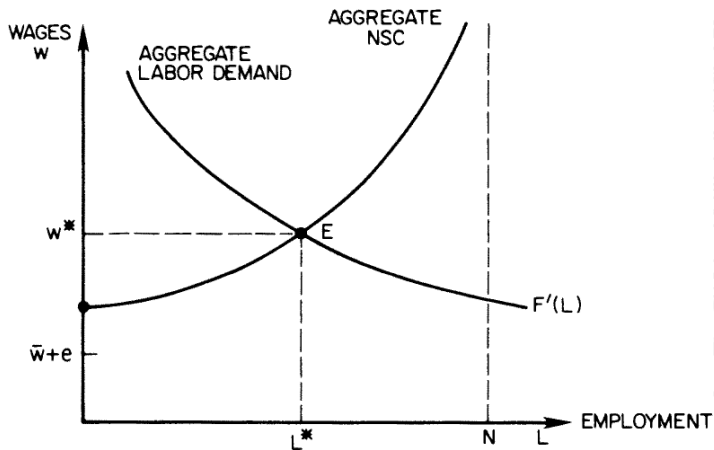
The model (cont'd)

- no shirking is inconsistent with full employment!
- since $a = \frac{bL}{N-L}$ if $L = N$ then $a \rightarrow +\infty$
- any shirker would be immediately rehired
- then workers would decide to shirk !
- each firm takes a as given and offers wage $\hat{w}$
- in equilibrium, *aggregate demand* for labour equals NSC
- assuming $\bar{w} = 0$

$$F'(L) = e + \frac{e}{q} \left(\frac{bN}{N-L} + r \right)$$



The model (cont'd)



Source: Shapiro and Stiglitz (1984, p. 439, fig. 2)



The model (cont'd)

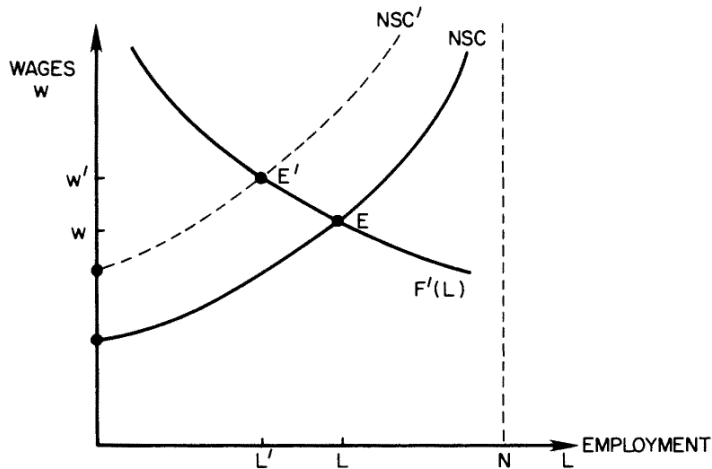
- **N.B.** unemployment is not of the search type
- all workers and firms are identical, and there is perfect information about job availability
- unemployed workers would be happy to work for less than the going wage but cannot make a *credible promise* not to shirk at such wages

comparative statics

- $b \uparrow$ or $q \downarrow$ cause $\hat{w} \uparrow$ and therefore NSC shifts upwards and unemployment $\uparrow$
- instead, $\bar{w} \uparrow$ cause both $NSC \uparrow$ and $F'(L) \downarrow$ because workers become more expensive
- both movements go in the direction of unemployment $\uparrow$
- but transition is sluggish: wage decreases by individual firms (demand $\downarrow$) become attractive only as unemployment pool grows (by means of $NSC \uparrow$)
- possible explanation for wage sluggishness in real economies



The model (cont'd)



Source: Shapiro and Stiglitz (1984, p. 439, fig. 3)



The model (cont'd)

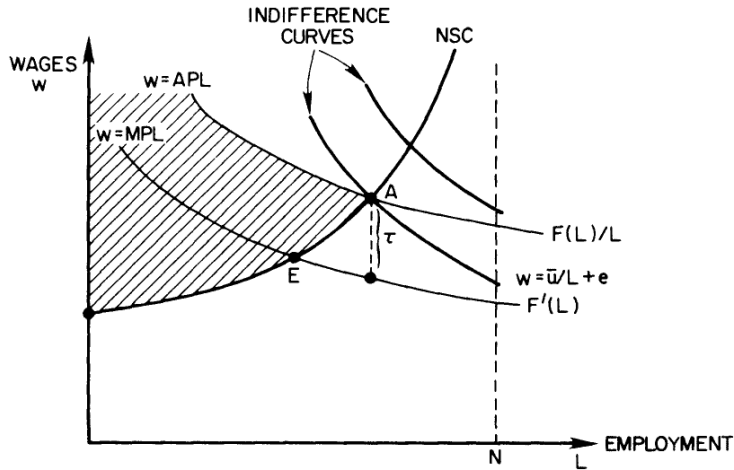
welfare analysis

- is the unemployment equilibrium Pareto optimal?
- need to consider ownership
- ownership of firms is equally distributed among the N workers
- central planning problem: maximise expected utility of representative worker subject to the NSC and resource constraint
- since workers are risk neutral, optimal $\bar{w} = 0$

$$\begin{array}{ll} \max_{w,L} (w - e)L & \text{subject to} \\ w \geq e + \frac{e}{q} \left(\frac{bN}{N-L} + r \right) & \text{(NSC)} \\ wL \leq F(L) \iff w \leq \frac{F(L)}{L} & \text{(feasibility)} \end{array}$$



The model (cont'd)



Source: Shapiro and Stiglitz (1984, p. 440, fig. 4)



The model (cont'd)

- with constant returns to scale the equilibrium is Pareto optimal
 - $F'(L) = \frac{F(L)}{L} \implies A = E$
 - but in general the equilibrium is *not* Pareto optimal
 - natural rate of unemployment is too high
 - a profit tax τ that subsidises wages is a strict Pareto improvement
- this is true when *workers = owners*
 - if *workers $\neq$ owners*, profit tax τ is *not* a Pareto improvement
 - in this case equilibrium *is* Pareto optimal
 - although it does *not* maximise national product
 - Pareto optimality depends on distribution of wealth
 - the standard equity/efficiency separation doesn't hold



Wrap up

- with imperfect monitoring, equilibrium entails unemployment
 - unemployment (job rationing) acts as a discipline device
 - unemployment benefits increase equilibrium unemployment rate
 - not only because of lack of incentives to search for jobs
 - they reduce the penalty associated with being fired
 - high labour turnover, monitoring costs, discount rates, all increase natural rate of unemployment
 - wages adjust slowly to aggregate shocks
 - labour demand ↓, wage ↓, unemployment ↑ (sluggish process)
 - market equilibrium in general is not Pareto optimal
 - there is too much unemployment
 - e.g. wage subsidies might bring a strict Pareto improvement
- focus of the analysis is on labour market
 - but can be easily generalised to any market equilibrium framework with *agency problems* and *quantity rationing*

