Labor Economics, 14.661. Lecture 8: Efficiency Wages

Daron Acemoglu

MIT

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Introduction

- First attempt to incorporate the internal organization of the firm with labor market equilibria: *efficiency wage models*.
- Very simple models of incentive problems (moral hazard or adverse selection) on the firm side combined with a simple model of the labor market.
- Canonical example: the Shapiro-Stiglitz model of efficiency wages due to moral hazard.
- Implications:
  - Labor demand reduced because of incentive problems$\longrightarrow$unemployment.
  - Interactions between incentives and markets ("unemployment as a discipline device").
  - Potential inefficiencies (but care is necessary...).

Environment

- Model in continuous time and all agents are infinitely lived.
- Workers have to choose between two levels of effort, and are only productive if they exert effort.

$$\longrightarrow \text{effort} \quad \begin{array}{ll} \longrightarrow 0 & \tilde{}\text{cost} = 0, \text{ not productive} \\ \longrightarrow 1 & \tilde{}\text{cost} = e, \text{ productive} \end{array}$$

- Without any informational problems firms would write contracts to pay workers only if they exert effort.
- The problem arises because firms cannot observe whether a worker has exerted effort or not, and cannot deduce it from output, since output is a function of all workers' efforts.
- This introduces the *moral hazard problem*.
- In addition, workers cannot be punished for low output.
- This introduces the *limited liability problem.*

Environment (continued)

- Continuous time⟶flow rates instead of probabilities.
- If a worker "shirks", there is effort $= 0$, then there is probability (flow rate) q of getting detected and fired.
  - why you? suppose that the worker's actions affect the probability distribution of some observable signal on the basis of which the firm compensates him.
- All agents are risk neutral, and there are N workers.
- Let

$b =$ exogenous separation rate
$a =$ job finding rate, which will be determined in equilibrium
$r =$interest rate/discount factor
$w =$ wage rate (not conditioned on past outcomes)

Dynamic Programming Equations

- Solution, using simple dynamic programming arguments.
- Let us simplify the analysis by focusing on steady states.
- Consider the present discounted values (PDV) of workers as a function of their "strategy" of shirking or working hard.

Dynamic Programming Equations (continued)

- Denote the PDV of employed-shirker by V_E^S

$$rV_E^S = w + (b+q)(V_U - V_E^S) \tag{1}$$

- Steady state: $\dot{V}_E^S = 0$ (otherwise $rV_E^S - \dot{V}_E^S = w + (b+q)(V_U - V_E^S)$).
- Intuition: the worker always receives his wage w.
- At the flow rate b, he separates from the firm exogenously, and at the flow rate q, he gets caught for shirking, and in both cases he becomes unemployed, receiving V_U and losing V_E^S.
- In continuous time, the probability that both events happen at the given instant is zero (or the probability that both events happen in a small interval is very very small).

Dynamic Programming Equations (continued)

- Similarly, let the PDV of employed-nonshirker be V_E^N:

$$rV_E^N = w - e + b(V_U - V_E^N). \tag{2}$$

- Different from the PDV of shirkers, (1), because the worker incurs the cost e, but loses his job at the slower rate b.
- PDV of unemployed workers V_U is

$$rV_U = z + a(V_E - V_U),$$

where

$$V_E = \max\left\{V_E^S, V_E^N\right\}$$

and z is the utility of leisure + unemployment benefit.

Dynamic Programming Equations (continued)

- Key object: *incentive compatibility constraint* for workers so that they prefer to exert effort rather than shirk.
- *Non-shirking condition*:

$$\begin{aligned} V_E^N &\geq V_E^S \\ w &\geq rV_U + e + (r+b)\frac{e}{q} \quad \text{[non-shirking condition]}. \end{aligned}$$

- Intuitively, the greater is the unemployment benefit and the greater is the cost of effort, the greater should the wage be.
- More importantly, the more likely the worker is to be caught when he shirks, the lower is the wage.
- Also, the wages higher when r and b are higher (Why?).

Equilibrium

- Steady state requires that $\Longrightarrow$

$$\text{flow into unemployment} = \text{flow out of unemployment}$$

- In equilibrium, no one shirks because the non-shirking condition holds (similar to the agents doing the right thing in the agency models).
- Therefore,

$$bL = aU$$

where L is employment, and U unemployment.

- This implies

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

Equilibrium (continued)

- Substituting, we obtain the full non-shirking condition as

$$\text{Non-Shirking Condition}: w \geq z+e+\left[r+\frac{bN}{N-L}\right]\frac{e}{q}$$

- A higher level of $\frac{N}{N-L}$, which corresponds to lower unemployment, necessitate a higher wage to satisfy the non-shirking condition. This is the sense in which unemployment is a worker-discipline device.
- Higher unemployment makes losing the job more costly, hence encourages workers not to shirk.
- Source of the idea that *unemployment is a worker discipline device* (what happens if unemployment is equal to 0?)

Equilibrium (continued)

- Non-shirking condition≈labor supply (why?)
- For equilibrium, we also need to consider labor demand.
- Suppose that there are M firms, each firm i with access to a production function

$$AF(l_i),$$

where l_i denotes their labor hired by firm i.
- Let us make the standard assumptions on F, in particular, it is increasing and strictly concave, i.e. $F'' < 0$.
- No adjustment costs are dynamics, so firms maximize static profits.
- Therefore,

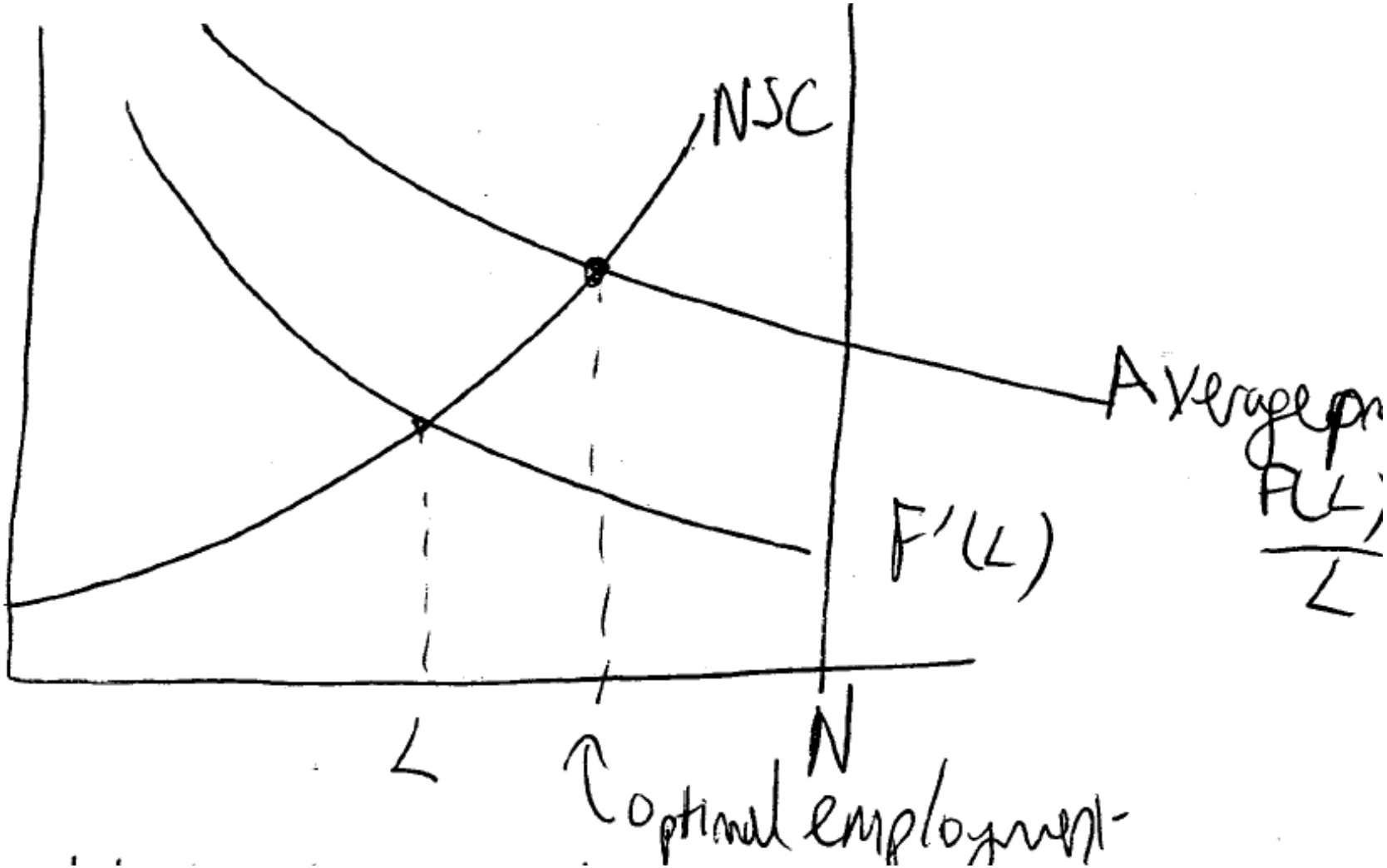
$$AF'(l_i) = w,$$

- Aggregate Labor Demand (using $l_i = L/M$ for all i):

$$AF'\left(\frac{L}{M}\right) = w.$$

Equilibrium (continued)

- Equilibrium in a picture (with $M = A = 1$):



Equilibrium (continued)

- Set $M = 1$ as a normalization.
- Then equilibrium given by

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

- Loosely speaking, labor demand equal to quasi-labor supply.

Comparative Statics

- Straightforward comparative statics
  - $A \downarrow \Longrightarrow L \downarrow$: lower prod. $\Longrightarrow$ high unemployment
  - $z \uparrow \Longrightarrow L \downarrow$: high reservation wages $\Longrightarrow$ high unemployment
  - $q \downarrow \Longrightarrow L \downarrow$: bad monitoring $\Longrightarrow$ high unemployment
  - $r \uparrow \Longrightarrow L \downarrow$: high interest rates $\Longrightarrow$high unemployment
  - $b \uparrow \Longrightarrow L \downarrow$: high turnover $\Longrightarrow$ high unemployment

Efficiency

- Since there is unemployment, rents and information problems here, it is also natural to ask the welfare question: is the level of unemployment too high?
- Answer: depends on what notion of welfare we are using and whether firms are owned by nonworkers.
- *Incorrect answer:* the equilibrium is Pareto suboptimal.
- Why is this incorrect?

Efficiency (continued)

- What are the externalities?

1. By hiring one more worker, the firm is reducing unemployment, and forcing other firms to pay higher wages→unemployment is too low.
2. By hiring one more worker, the firm is increasing the worker's utility at the margin, since each worker is receiving a rent (wage > opportunity cost)→unemployment is too high.

- The diagram shows that the second effect always dominates (now consider the average product line).
- The unemployment is too high from the viewpoint of *maximizing total output* or net surplus.
- Maximum output when w =average productive labor. Why?

Why Not Pareto Improvements?

- A subsidy on wages financed by a tax on profits will increase output.
- But this is *not* a Pareto improvement.
- Who owns the firms?
- If firms are owned by capitalists, the above policy will increase output, but will not constitute a Pareto improvement.
- If firms are owned by workers, the above policy will constitute a Pareto improvement.
  - But in this case workers have enough income.
  - Why do they not already enter into "bonding" contracts or at least write better contracts as in our moral hazard models?

Other Solutions to Incentive Problems

- This discussion already suggests that constant wages are not optimal.
- What will optimal wage schedules look like?
  - If workers are not credit constraint and no limited liability, *bonding contracts*.
  - If limited liability, then *backloaded compensation*
- What is the problem with backloading?
  - Perhaps firm-side moral hazard—firms may claim workers have shirked and fire them either to reduce labor costs when the worker's wage has increased enough (above the opportunity cost), or to collect the bond payments.

Evidence on Efficiency Wages

- Two types of evidence offered in the literature in support of efficiency wages.
- *First:* presence of substantial inter-industry wage differences (e.g., Krueger and Summers).
  - Such wage differentials are consistent with efficiency wage theories since the monitoring problem (q in terms of the model above) is naturally more serious in some industries than others. But they are also consistent with lots of other models.
  - Moreover, the exact extent of "true" inter-industry wage differentials is quite debatable (e.g., Abowd, Kramartz and Margolis).
  - For example, these differentials may reflect compensating wages (since some jobs may be less pleasant than others) or premia for unobserved characteristics of workers, which differ systematically across industries because workers select into industries based on their abilities.

Evidence on Efficiency Wages (continued)

- How can we control for compensating wage differentials?
  1. Look at wage changes for workers who change industries (Krueger and Summers; Gibbons and Katz). What is wrong with this exercise?
  2. Do workers vote with their feet? Quitting behavior (Krueger and Summers) and queuing behavior (Holzer, Katz, and Krueger).

Evidence on Efficiency Wages (continued)

- *Second:* look for direct evidence for efficiency wage considerations.
- A number of studies find support for efficiency wages. These include:

1. Krueger compares wages and tenure premia in franchised and company-owned fast food restaurants. Idea: less monitoring of workers in a franchised restaurant. This is reasonable?
2. Cappelli and Chauvin: look at the number of disciplinary dismissals, which they interpret as a measure of shirking, in the different plants located in different areas, but all by the same automobile manufacturer (and covered by the same union). The firm pays the same nominal wage everywhere (because of union legislation). This nominal wage translates into greater wage premia in some areas because outside wages differ. Result: when wage premia are greater, there are fewer disciplinary dismissals. Is this sufficient evidence?
3. Bewley and Campbell and Kamlani survey evidence. Firms often unwilling to cut wages because this will reduce worker effort and increase shirking. Alternative explanations?

Efficiency Wages, Monitoring and Corporate Structure

- Let us try to take a further step towards introducing "corporate structure" (as measured by monitoring) into equilibrium models.
- Proxy monitoring by the number of supervisors to production workers).
- For simplicity: a one-period economy consisting of a continuum of measure N of workers and a continuum of measure 1 of firm owners who are different from the workers.
- Each firm i has the production function $AF(L_i)$.

Environment

- Differently from the Shapiro-Stiglitz model, let the probability of catching a shirking worker be endogenous.
- In particular, let $q_i = q(m_i)$ where m_i is the degree of monitoring per worker by firm i.
- The cost of monitoring for firm i which hires L_i workers is sm_iL_i ($m_i \approx$ number of managers per production worker and s as the salary of managers)
- Limited liability constraint$\longrightarrow$ workers cannot be paid a negative wage.
- Therefore, worst thing for a worker is to receive zero income.
- Since all agents are risk-neutral, without loss of generality, restrict attention to the case where workers are paid zero when caught shirking.

Incentive Compatibility

- Incentive compatibility constraint of a worker employed in firm i can be written as:

$$w_i - e \geq (1 - q_i) w_i.$$

- If the worker exerts effort, he gets utility $w_i - e$, which gives the left hand side of the expression.
- If he chooses to shirk, he gets caught with probability q_i and receives zero. If he is not caught, he gets w_i without suffering the cost of effort.

Firm Maximization

- Firm maximization:

$$\max_{w_i, L_i, q_i} \Pi = AF(L_i) - w_i L_i - sm_i L_i \tag{3}$$

subject to:

$$w_i \geq \frac{e}{q(m_i)} \tag{4}$$

$$w_i - e \geq \underline{u} \tag{5}$$

- The first constraint is the incentive compatibility condition rearranged.
- The second is the participation constraint where $\underline{u}$ is the *ex ante* reservation utility (outside option) of the worker; in other words, what he could receive from another firm in this market.
- This ex ante reservation utility will act *as a price* to clear the market.

Equilibrium

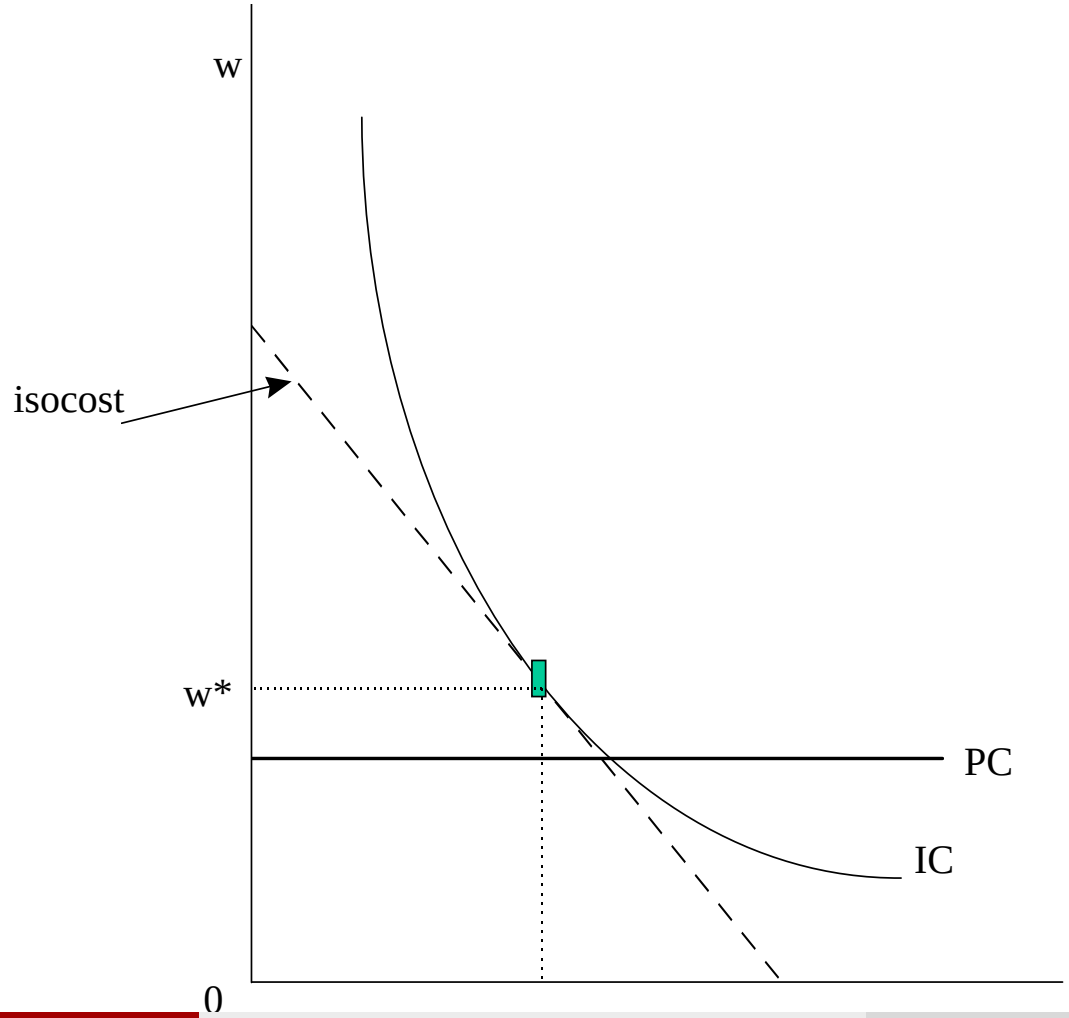
- The firm maximization problem (3) has a recursive structure:
  - m and w can be determined first without reference to L by minimizing the cost of a worker $w + sm$ subject to (4) and (5);
  - then, once this cost is determined, the profit maximizing level of employment can be found;
  - each subproblem is strictly convex, so the solution is uniquely determined, and all firms will make the same choices;
  - $m_i = m$, $w_i = w$ and $L_i = L$.
- Therefore, unique symmetric equilibrium.

Equilibrium

- Another useful observation: the incentive compatibility constraint (4) will always bind (why?)
- The participation constraint (5) may or may not bind
- Therefore two cases to consider depending on whether the participation constraint binds.

Equilibrium (continued)

- When (5) does not bind, the solution is characterized by the tangency of the (4) with the per-worker cost $w + sm$.



Equilibrium (continued)

- Call this solution (w^*, m^*), where:

$$\frac{eq'(m^*)}{(q(m^*))^2} = s \text{ and } w^* = \frac{e}{q(m^*)}. \tag{6}$$

- In this case, because the participation constraint (5) does not bind, w and m are given by (6).
- *Important implication*: small changes in $\underline{u}$ leave these variables unchanged.

Equilibrium (continued)

- In contrast, if (5) binds, w is determined directly from this constraint as equal to $\underline{u} + e$, and an increase in $\underline{u}$ causes the firm to raise this wage.
- Since (4) holds in this case, the firm will also reduce the amount of information gathering, m.

Equilibrium (continued)

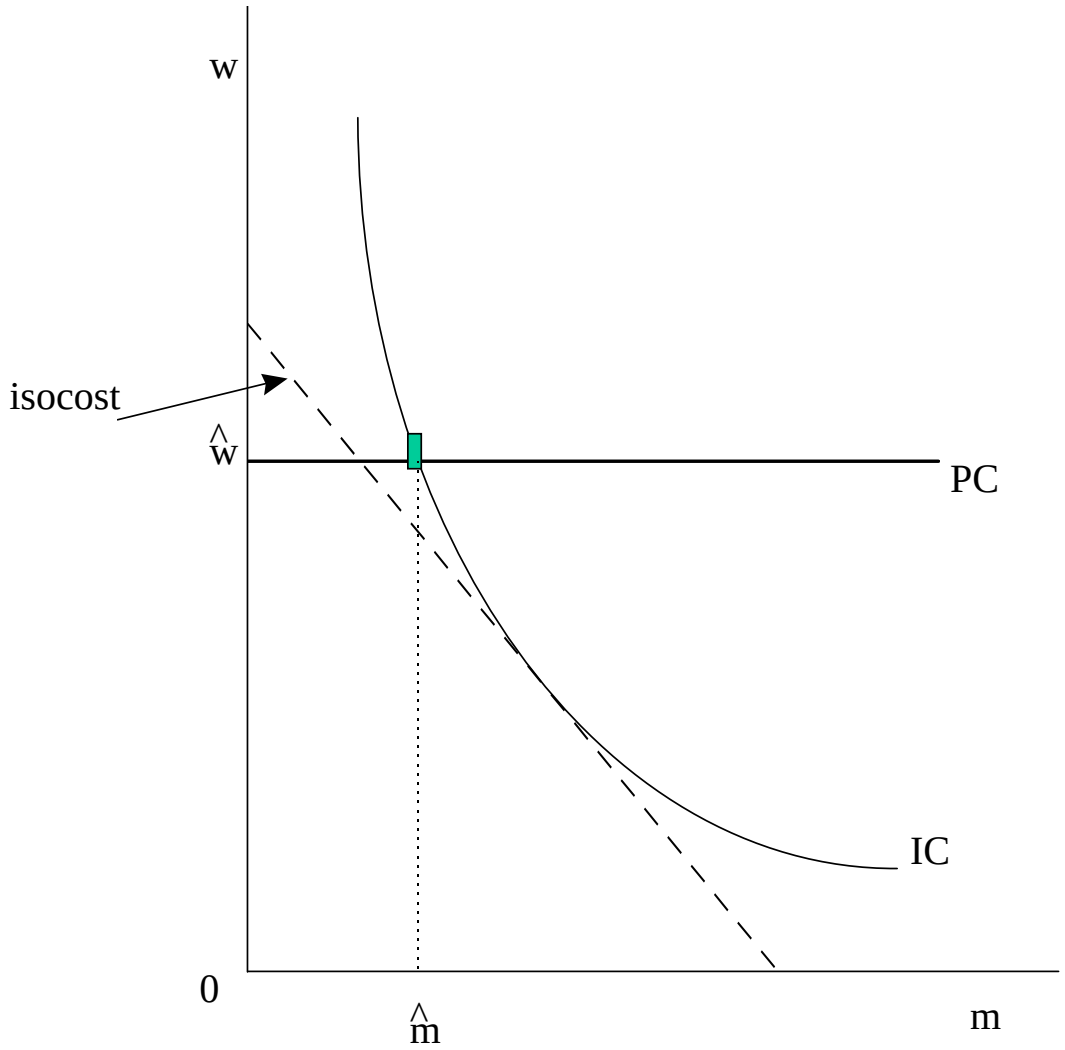


Figure: Participation Constraint is Binding.

Equilibrium (continued)

- What determines whether (5) binds?
- Let $\hat{w}$ and $\hat{m}$ be the per-worker cost minimizing wage and monitoring levels (which would not be equal to w^* and m^* when (5) binds).
- Then, labor demand of a representative firm solves:

$$AF'(\hat{L}) = \hat{w} + s\hat{m}. \tag{7}$$

- Next, using labor demand, we can determine $\underline{u}$, workers' *ex ante* reservation utility from market equilibrium as the appropriate price of labor.

Equilibrium (continued)

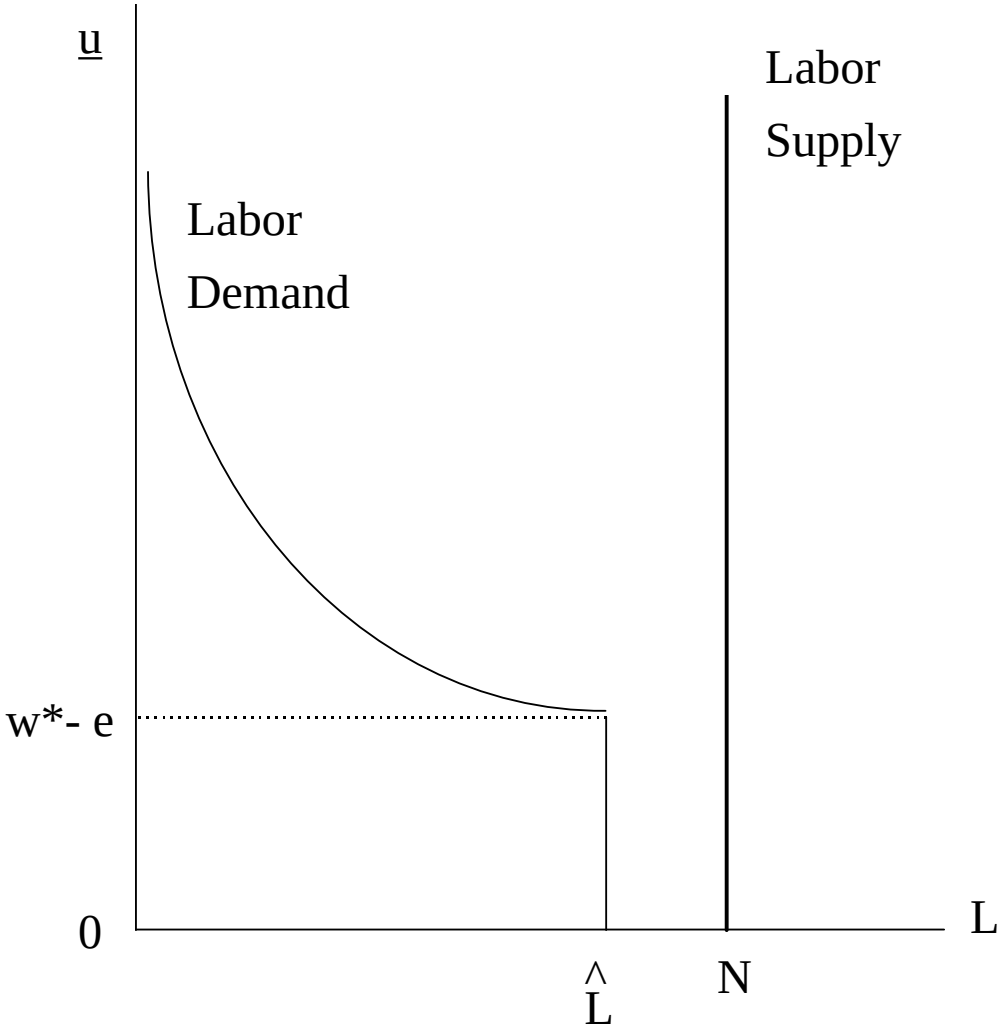


Figure: Participation Constraint is Slack.

Equilibrium (continued)

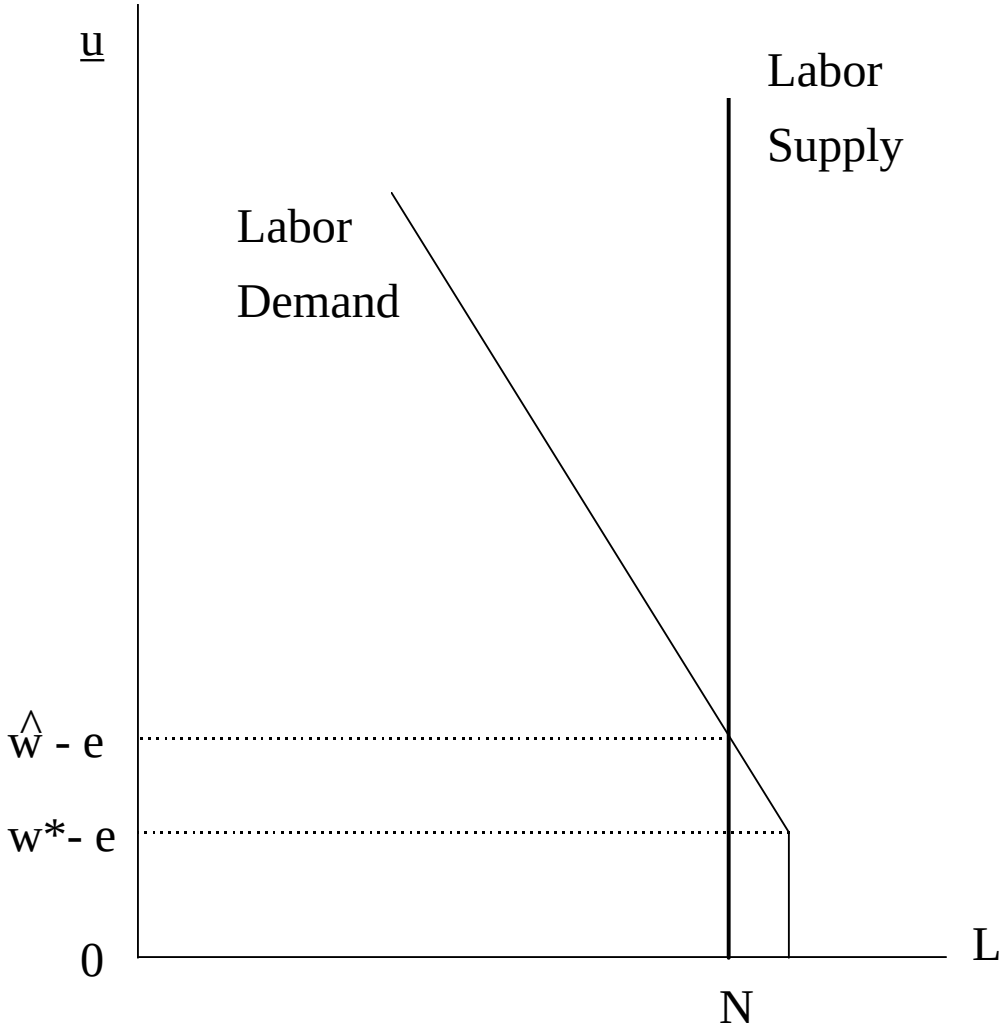


Figure: Participation Constraint is Binding.

Comparative Statics (continued)

- What is the effect of a minimum wage on unemployment, monitoring, wages?
- Answer: it depends on whether the participation constraint is binding or not.

Efficiency

- Consider the aggregate surplus Y generated by the economy:

$$Y = AF(L) - smL - eL, \tag{8}$$

where $AF(L)$ is total output, and eL and smL are the (social) input costs.

- Equilibrium is constrained Pareto efficient: subject to the informational constraints, a social planner could not increase the utility of workers without hurting the owners.
- But total surplus Y is never maximized in equilibrium. Why?
- We can reduce q without changing L, increasing Y.
- This can be achieved with a tax on profits used to subsidize w (which will relax the incentive constraint (4) and allow a reduction in monitoring).