13B. Information Asymmetries and Adverse Selection

1. The simple labor market model from Akerlof (1970)

- Setting:
- Workers type: **Θ** is in (θ_, θ upper bar)
- Price of the output is 1
- Reservation wage **r(θ)**

When we can observe productivity, wage = MP_L or w*(θ) = θ
The set of workers are {θ: r(θ) < θ)

The total welfare is

$$I(\theta) = \begin{cases} 1 & \text{if type } \theta \text{ works} \\ 0 & \text{if not} \end{cases}$$

$$W = \int_{\underline{\theta}}^{\bar{\theta}} N \Big[\underbrace{I(\theta)\,\theta}_{\text{Firm rev}} + \underbrace{(1 - I(\theta))}_{\text{Home consumption}} r(\theta) \Big] \, dF(\theta)$$

- If workers' types are not observable

A worker of type θ is willing to work for a firm if and only if $r(\theta) \leq w$. Hence, the set of worker types who are willing to accept employment at wage rate w is

$$\Theta(w) = \{\theta: r(\theta) \leq w\}. \qquad (13.B.2)$$

Consider, next, the demand for labor as a function of w. If a firm believes that the average productivity of workers who accept employment is μ, its demand for labor is given by

$$z(w) = \begin{cases} 0 & \text{if } \mu < w \\ [0, \infty] & \text{if } \mu = w \\ \infty & \text{if } \mu > w. \end{cases} \qquad (13.B.3)$$

So in equilibrium, we must have

Definition 13.B.1: In the competitive labor market model with unobservable worker productivity levels, a *competitive equilibrium* is a wage rate w^* and a set Θ^* of worker types who accept employment such that

$$\Theta^* = \{\theta : r(\theta) \leq w^*\} \tag{13.B.4}$$

and

$$w^* = E[\theta \mid \theta \in \Theta^*]. \tag{13.B.5}$$

2. Asymmetric Information and Pareto Inefficiency

Consider **r(θ) = r**
F(r) is in (0,1), so some **θ < r , some θ > r**

if $w > r \Rightarrow$ every one $[\underline{\theta}, \bar{\theta}]$ accepts
$\Theta(w) = [\underline{\theta}, \bar{\theta}]$

if $\underline{w < r} \Rightarrow$
$\Theta(w) = \emptyset$

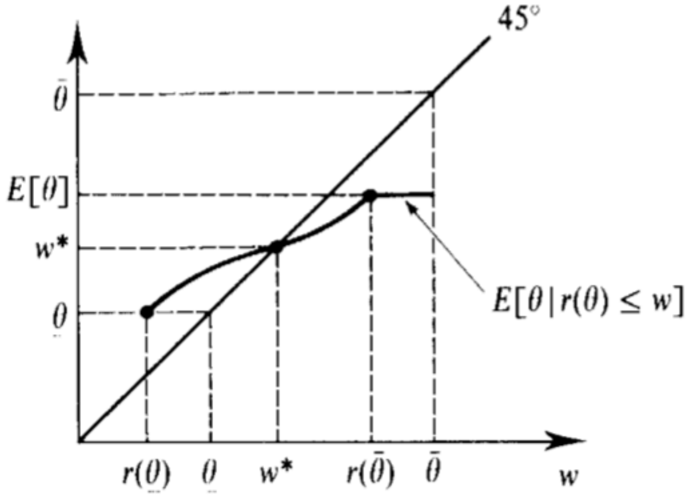
The key of this model is the equilibrium depends on the relative fractions of good and bad workers.

The cause of this failure of the competitive allocation to be Pareto optimal is simple to see: because firms are unable to distinguish among workers of differing productivities, the market is unable to allocate workers efficiently between firms and home production.[6]

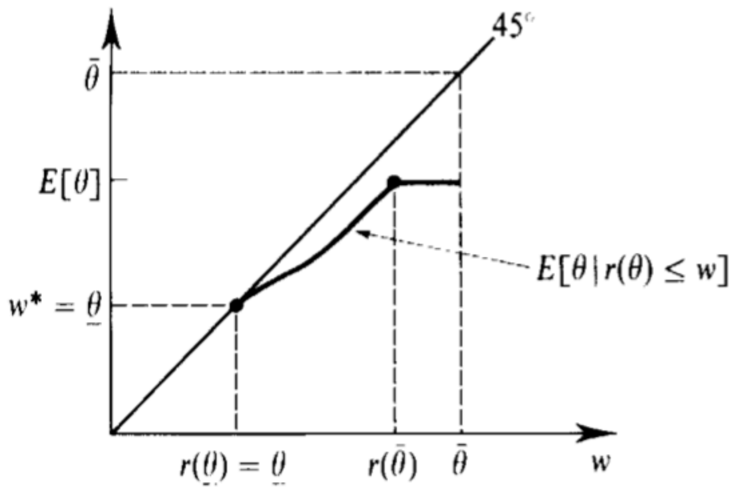
3. Adverse Selection

Consider **r(θ) increases in θ**

To see the power of adverse selection, suppose that $r(\theta) \leq \theta$ for all $\theta \in [\underline{\theta}, \bar{\theta}]$ and that $r(\cdot)$ is a strictly increasing function. The first of these assumptions implies that the Pareto optimal labor allocation has every worker type employed by a firm. The second assumption says that workers who are more productive at a firm are also more productive at home. It is this assumption that generates adverse selection: Because the payoff of home production is greater for more capable workers, only less capable workers accept employment at any given wage w [i.e., those with $r(\theta) \leq w$].



Ideally we want to be at r(**θ upper bar)**. But firm cannot distinguish high/low types
And At the point **firm cannot break even.** Thus, best workers are out of market.



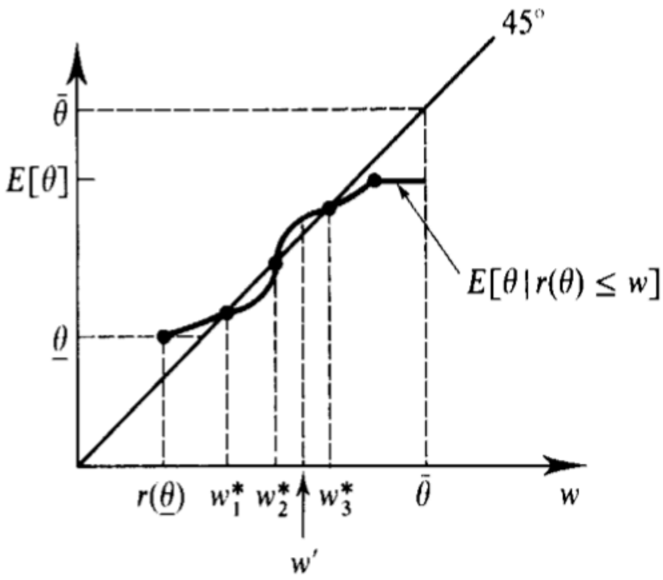
In the pic above, we see the equilibrium wage is **θ lower bar**.
Because of adverse selection, essentially no workers are hired (more precisely, a
Set of measure 0)

- An example

Example 13.B.1: To see an explicit example in which the market completely unravels let $r(\theta) = \alpha\theta$, where $\alpha < 1$, and let θ be distributed uniformly on $[0, 2]$. Thus, $r(\underline{\theta}) = \underline{\theta}$ (since $\underline{\theta} = 0$), and $r(\theta) < \theta$ for $\theta > 0$. In this case, $E[\theta \mid r(\theta) \leq w] = (w/2\alpha)$. For $\alpha > \frac{1}{2}$, $E[\theta \mid r(\theta) \leq 0] = 0$ and $E[\theta \mid r(\theta) \leq w] < w$ for all $w > 0$, as in Figure 13.B.2.[10]

So we see the expectation of the pool of workers given wage W is less than W.

- A constrained Pareto-Optimal



The equilibrium with the highest wage Pareto dominates all others.
The Pareto-dominated equilibria arise because of a **coordination failure.**

4. A Game-Theoretic Approach

To be more formal about this idea, consider the following game-theoretic model: The underlying structure of the market [e.g., the distribution of worker productivities $F(\cdot)$ and the reservation wage function $r(\cdot)$] is assumed to be common knowledge. Market behavior is captured in the following two-stage game: In stage 1, two firms simultaneously announce their wage offers (the restriction to two firms is without loss of generality). Then, in stage 2, workers decide whether to work for a firm and, if so, which one. (We suppose that if they are indifferent among some set of firms, then they randomize among them with equal probabilities.)[11]

Proposition 13.B.1: Let W^* denote the set of competitive equilibrium wages for the adverse selection labor market model, and let $w^* = \text{Max}\,\{w\colon w \in W^*\}$.

(i) If $w^* > r(\underline{\theta})$ and there is an $\varepsilon > 0$ such that $E[\theta \mid r(\theta) \leq w'] > w'$ for all $w' \in (w^* - \varepsilon, w^*)$, then there is a unique pure strategy SPNE of the two-stage game-theoretic model. In this SPNE, employed workers receive a wage of w^*, and workers with types in the set $\Theta(w^*) = \{\theta\colon r(\theta) \leq w^*\}$ accept employment in firms.

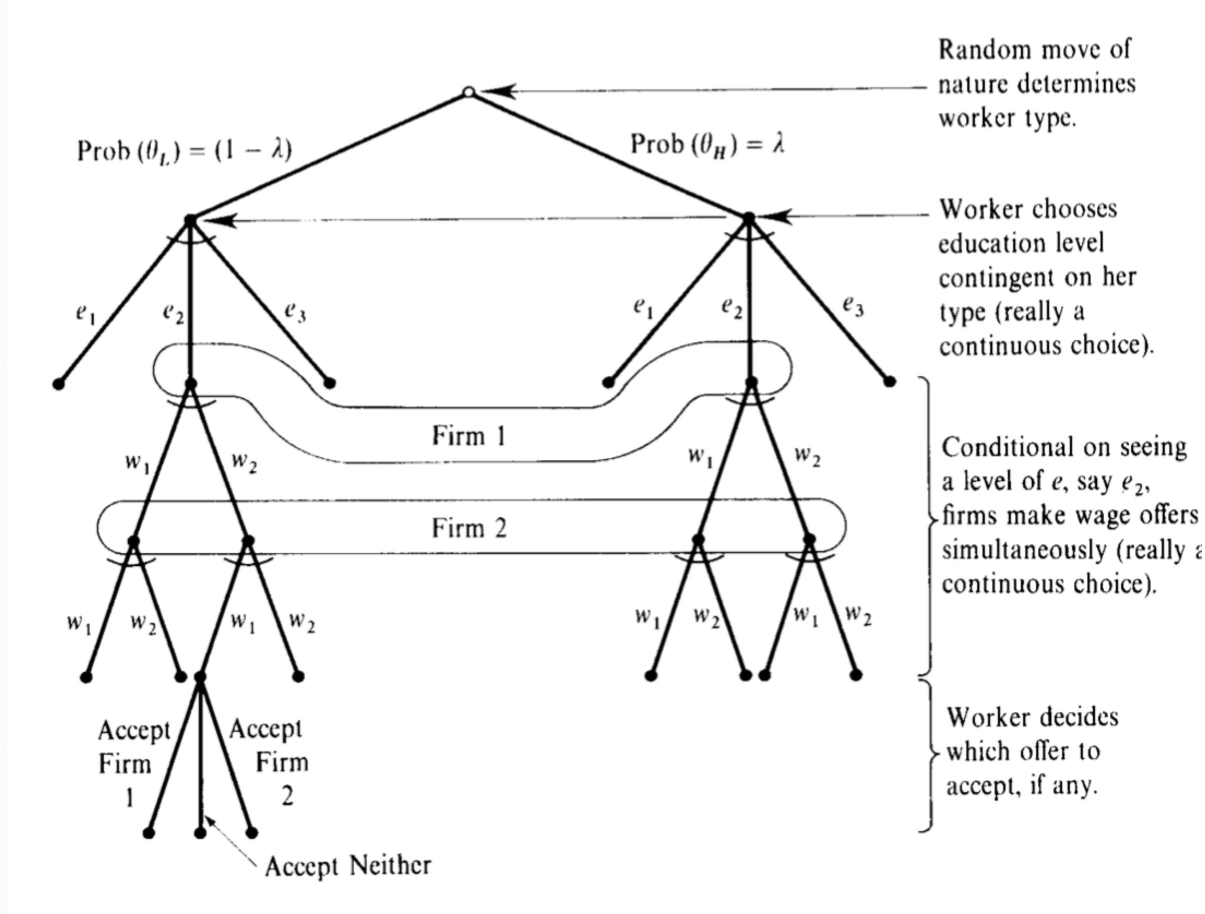
(ii) If $w^* = r(\underline{\theta})$, then there are multiple pure strategy SPNEs. However, in every pure strategy SPNE each agent's payoff exactly equals her payoff in the highest-wage competitive equilibrium.

13C. Signaling, Spence (1973, 1974)

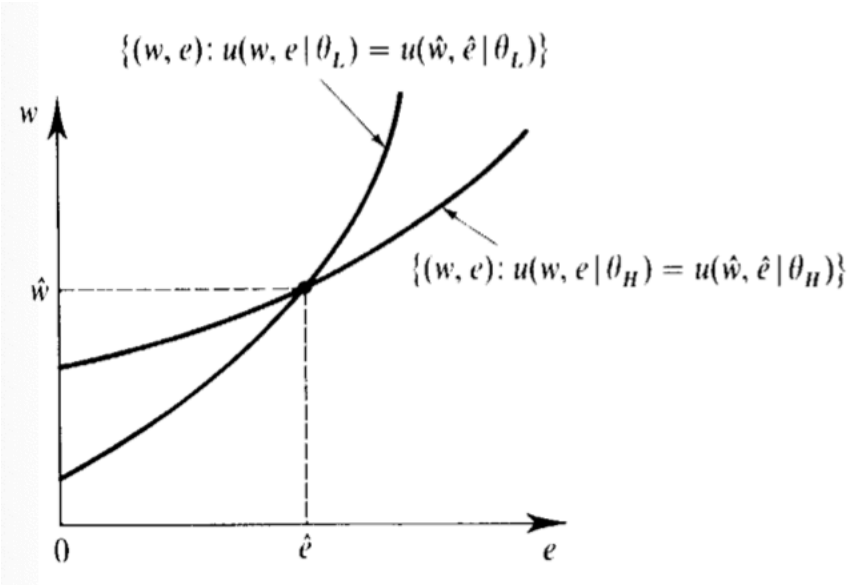
The idea is that high-ability workers may have actions they can take to distinguish themselves from low type counterparts.

If no signaling, we have pareto optimal. W*= E[θ]

1. **Extensive form of the education signaling game**



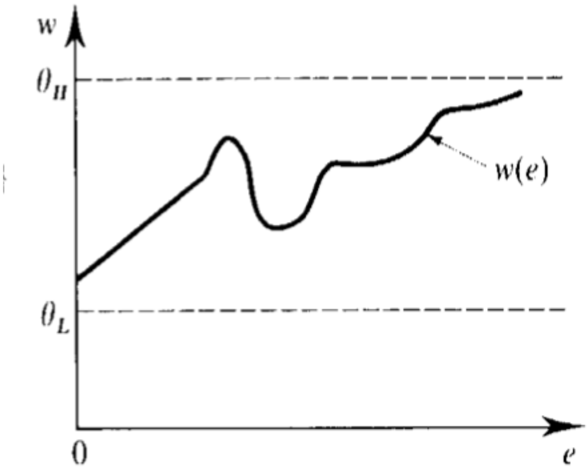
We consider only one worker.



For high type, the curve is flatter. (a small wage increase - a lot of education)

axis). Note that these indifference curves cross only once and that, where they do, the indifference curve of the high-ability worker has a smaller slope. This property of preferences, known as the *single-crossing property*, plays an important role in the analysis of signaling models and in models of asymmetric information more generally. It arises here because the worker's marginal rate of substitution between wages and education at any given (w, e) pair is $(dw/de)_{\bar{u}} = c_e(e, \theta)$, which is decreasing in θ because $c_{e\theta}(e, \theta) < 0$.

Then we graph the function giving the equilibrium wage offer that results for each education level



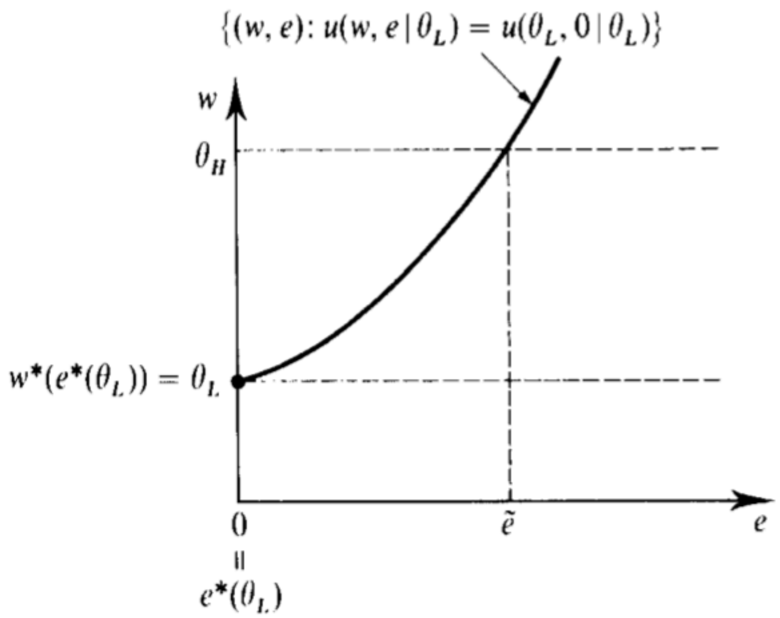
2. **Separating Equilibrium**

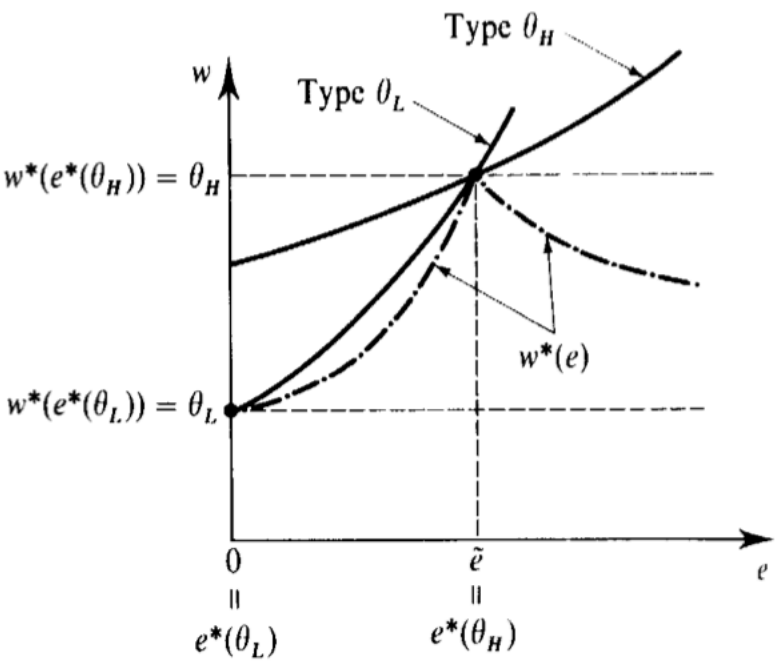
To analyze separating equilibria, let $e^*(\theta)$ be the worker's equilibrium education choice as a function of her type, and let $w^*(e)$ be the firms' equilibrium wage offer as a function of the worker's education level. We first establish two useful lemmas.

Lemma 13.C.1: In any separating perfect Bayesian equilibrium, $w^*(e^*(\theta_H)) = \theta_H$ and $w^*(e^*(\theta_L)) = \theta_L$; that is, each worker type receives a wage equal to her productivity level.

Lemma 13.C.2: In any separating perfect Bayesian equilibrium, $e^*(\theta_L) = 0$; that is, a low-ability worker chooses to get no education.

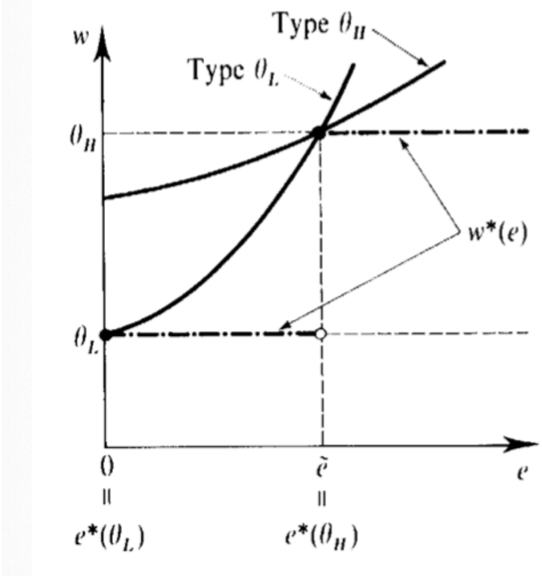
The idea is that low type worker gets no education. The second graph describes a separating equilibrium.

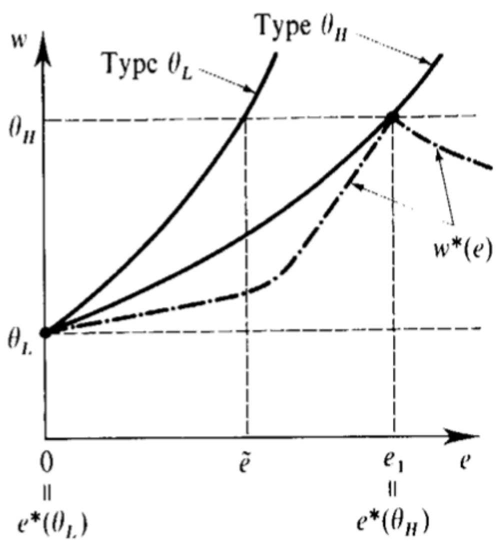


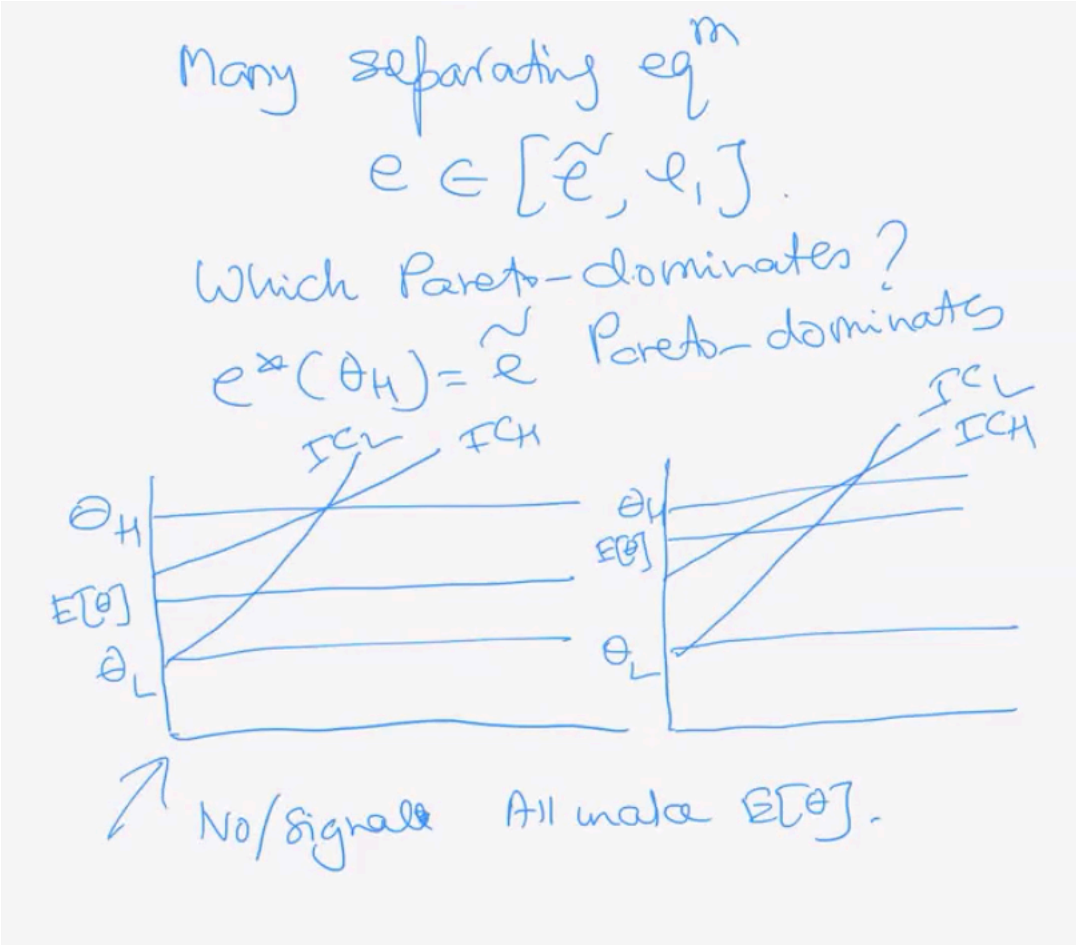


- If firm's beliefs off the equilibrium path. In this PBE, firms believe that the worker is certain to be of high quality if e>= e tilted.
  Then we have high types are willing to get useless education to distinguish them from low types.

- The fundamental reason is that education can serve as a signal.





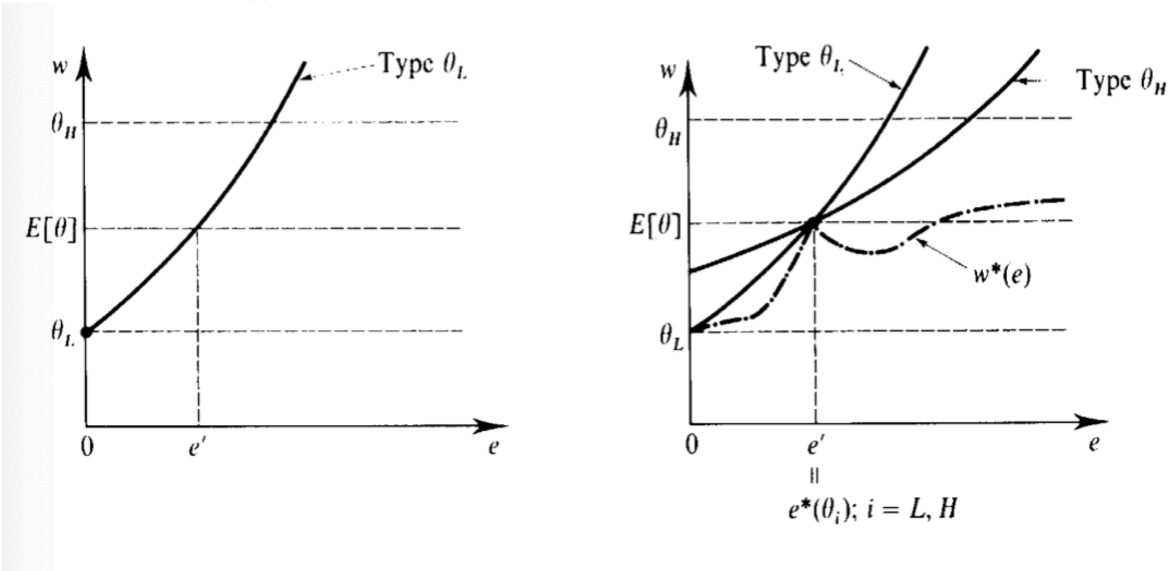


- On the left side,
  With signaling => everyone makes E[theta]
  H type better with signaling, L worse off

- **On the right side, (more high type workers)**
  With signaling => everyone worse off
  Social inefficiency arises because high type all try to get education to distinguish them from low types.

3. Pooling Equilibrium

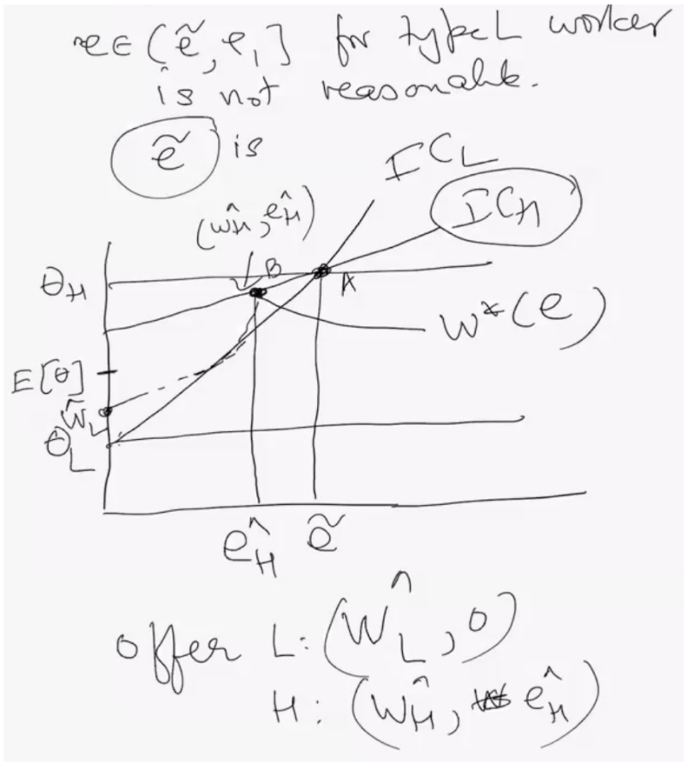
Consider two types choose the same level of education **e***



All pooling equilirbia are weakly dominated by no signaling equilibria (e=0).

Pareto-dominated pooling equilibria are sustained by the worker's fear that a deviation will lead firms to have an unfavorable impression of her ability. Note also that a

4. Multiple Equilibria and Equilibrium Refinement



Cross-subsidizing => pareto optimality