Simplified version of the well-known model introduced by Spence (1973).

There are two groups of workers:

- workers of type I
- workers of type II

respectively characterized by a productivity level:

- equal to **1**
- equal to **2**.

The firm ex ante knows that:

- Workers of type I → q
- Workers of type II → (1-q)

Denote:

- y = length of time devoted to education by workers.

Correlation between the productivity of each individual and the cost incurred by the individual for the acquisition of education:

- workers of type I:

$$C_I(y)=y$$

- workers of type II:

$$C_{II}(y)=y/2$$

The firm fixes:

$$y^* =$$ signal of high productivity

- And those who present this level are consequently paid a wage equal to:

$$w_2 = 2.$$

The level y * is an equilibrium with signal if, on the basis of an evaluation of

- the benefits (higher wages) and
- the costs associated with achieving that level y*,

$\Rightarrow$the most productive workers spontaneously decide to acquire it, and the less productive decide not to acquire it.

What conditions must be satisfied?

The workers of type II choose to acquire y* if:

$$w_2 - w_1 \geq y^*/2 \qquad (1)$$

Since:

$w_2 = 2$ and

$w_1 = 1$

we get:

$1 \geq y^*/2$

$\Rightarrow y^* \leq 2$

The workers of type I decide not to acquire y* if:

$$w_2 - w_1 \leq y^* \qquad (2)$$

and, since:

$w_2=2$ and $w_1=1$:

$$\Rightarrow 1 \leq y^*$$

We get the following condition:

$$\mathbf{1 \leq y^* \leq 2} \qquad \mathbf{(3)}$$

Figure 1 graphically illustrates this example

- C_I and C_{II} represent the cost functions of education for the two groups of workers (for each level of education $C_{II} < C_I$).
- The broken line denotes the remuneration of workers according to the level of education:

  For levels of education lower than y* workers perceive a wage equal to 1,
  and for levels of education greater than y*, workers perceive a wage equal to 2.

If:

$$1<y^*<2$$

the net benefit a worker of type I gets from the level of education y* is:

$$2 - C_I(y^*) = AB<1$$

lower than the net salary he can get with a level of education equal to 0

The net benefit a worker of type II gets from the level of education y* is:

$$2 - C_{II}(y^*) = AC > 1$$

greater than the net salary he can get with a level of education equal to 0

Note:

the optimal choice on the length of the period of education here will take only two values, 0 or y*.

- Who decides not reach y* has no incentive to study for a number of years greater than 0
- Those who choose to acquire the signal y* have no reason to go further.

In our example if the firm sets a threshold value of y (y*) included between 1 and 2 (the productivity level of the two types of workers) we get

a screening equilibrium !!

A situation in which:

- who owns the signal (threshold value of the number of years of education) is considered productive;
- only for the more productive agents it is convenient to acquire the signal;
- the firm's belief that the acquisition of the signal is a test of quality is confirmed by the facts.

The screening equilibrium exists because we have assumed that:

$$C_I(y) \neq C_{II}(y)$$

If we assume that:

$$C_I(y) = C_{II}(y)$$

We get a **Pooling equilibrium:**

- each worker chooses the same level of education and firm's optimal strategy is to offer a wage based on the average productivity, otherwise she would have to pay each worker a wage $w_2=2$

Properties of equilibrium

1. **Social optimality**.

Once the threshold value of the signal has been chosen by the firm,

- each worker rationally chooses (ie maximizing the difference between benefits and costs) whether to acquire the signal.
- **Individual choice** of each worker is optimal,
- but what about ***social optimality***?

- In equilibrium, the firm hires
  - a fraction q of workers of type I with:

$$w_1 = 1$$

  - and (1 - q) workers of type II with:

$$w_2 = 2$$

The average productivity obviously is:

$$q + 2(1 - q) = 2 - q.$$

- $q + 2(1 - q) = 2 - q$ is also the level of the average wage.

However, if the firm chooses workers randomly, offering them the average salary (2 – q), without distinction, the expected average productivity would be the same, and also the expected profits.

=> For the firm, the two situations are identical!!!

For what concerns the population of all workers, the total amount of wages in the two situations is also the same:

- signaling equilibrium $\Rightarrow$ $\boldsymbol{2(1-q)+1q=2-q}$

- Not signaling equilibrium $\Rightarrow$

$$\boldsymbol{(2-q)\,(1-q)+q(2-q)=(2-q)\,(1-q+q)=2-q}$$

BUT :

- in the signaling equilibrium some workers have to bear the cost of acquisition of the signal.

  $\Rightarrow$Workers' total welfare is lower.

  $\Rightarrow$The cost imperfect information imposes on society.

Let’s verify if for two groups of workers the screening equilibrium is better than the equilibrium with no signal.

- **Workers of type I**:

Obviously screening equilibrium is worse:

- they are paid:

$w_1 = 1$

- instead of:

$w = (2 - q) > 1$

- **<u>Workers of type II</u>**:

also for them the screening equilibrium can be worse!!!

If:

$$2 - C_{II}(y^*) < 2 - q \qquad (4)$$

(net benefit < average wage)

- Also they would prefer the situation in the absence of signal.

Numerical example:

$$q = 0,5 \text{ and } y^* = 1,5$$

condition (4) is certainly verified:

In fact:

$$2 - y^*/2 = 2-0,75 = 1,25<1,5 \ (=2 - q)$$

net benefit < average wage

- In this case, if the firm adopts signal y*, workers of type II should acquire it, because the net benefit (1.25) is greater than 1 (the wage they would receive if they did not acquire any education).

- But workers of type II would prefer an equilibrium in which the firm is not screening the market.

$\Rightarrow$asymmetric information, and the need to solve it, impose costs in terms of welfare.

⇒Acquiring the **signal** "education" is a waste from a social point of view.

- Most productive workers acquire the signal **ONLY** to differentiate themselves from less productive workers and not because it implies an increase of their level of productivity.
- The output produced is the same as in the absence of the signal.
- There is only an increase in the costs that must be borne by workers who acquire the signal.

2. The second aspect to emphasize, in analyzing the properties of a signaling equilibrium is that:

- ∞ **equilibria may exist**.

- There is not a precise level of education y*, but a range of values for the signal

For example, a range of values may be:

- the years of study are between 13 and 16 (diploma and undergraduate degree) or between 16 and 18 (undergraduate degree and master). And the firm can choose a value between them.

- In these cases, however, equilibria with highest signal (eg. $y^* = 16$) are dominated by equilibria with the lowest signal (eg. $y^* = 13$),
- because the productivity does not increase, neither the wages nor the profits,
- but only the cost of acquiring education increases

The relationship age – remuneration.

- It is empirically verified that a positive relationship between age and salary exists.
- One explanation: human capital increases with experience (age) and hence also wage increases
- Alternative explanation:

Salop J. and S. Salop (1976), Self-Selection and Turnover in the Labor Market, *The Quarterly Journal of Economics,* 90 (4): 619-627

process of screening projected by the firms to reduce employees' turnover