Recruitment
(Ch 2 2nd ed. / Ch 3, 4, 8 1st ed.)

- Adverse Selection

- Screening (2 examples)
- Screening (formal model)

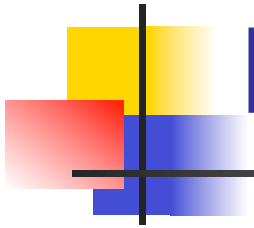
- Probation wage model
- Probation wage model extension

- Signaling model
  - An Extension to Research on Whether Education is a Signal

Recruitment

- In the last chapter, we looked at whether firms should hire high or low skill workers
- Suppose the firm has decided it wants skilled workers
- How does it go about hiring them?
  - Big problem: Adverse selection

Adverse Selection: Motivating Question



- Suppose you know how well you will do in the class, but I don't.
- Suppose the TAs don't want to grade a lot of exams.
- Suppose that today, I offer to give anyone a guaranteed B- if they skip all of the exams.

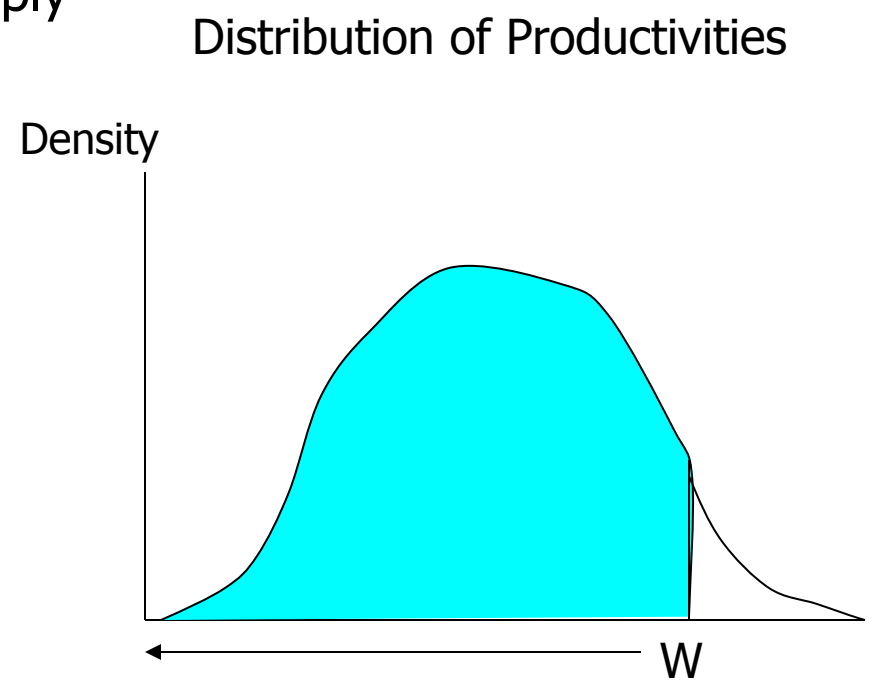
- Which students would take the offer?
  - above average
  - below average
  - everyone

Hiring the Right People

- How do you find the most able people for a given job?
- Offer high wages?
  - Suppose worker productivity in all firms is equal and workers know productivity but firms do not
  - Workers know that they can earn their productivity somewhere, they have "outside options" equal to their productivity
  - Say firm pays the average wage
  - Will it get workers who are:
    - A. Better than average
    - B. Less than average
    - C. Average

Adverse Selection

- If firm offers $20/hr then only workers with <=$20/hr productivity are apt to apply
- This is called Adverse Selection

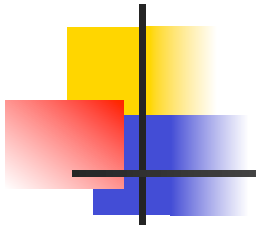


Adverse Selection

- CNN Article: Some employers consider 90% of applicants to be unqualified.

- http://money.cnn.com/2009/02/18/news/economy/lousy_job/

Addressing Adverse Selection



- Pay to screen workers
- Offer probation wages
- Require credential as signal of ability
- Offer contingent contract, “piece-rate” compensation based on worker output
  - We will study this later

Screening

- A firm can "screen out" certain types of workers by testing them before hiring them, and rejecting workers that do not "pass" the test.
- This allows the firm to address adverse selection by rejecting applicants at the bottom end of the productivity distribution.
- We assume all workers receive the same wage.
- We assume here that high-ability workers do not have outside options, so even if they know they are high-productivity, they will come to work at the firm. Therefore the firm can make profits from these workers as the productivity of these types exceeds their wage.

An Investment Banking Example of the Value of Screening

- Pay $40 per year.
- Assume can hire any # of workers, so max π/worker.
- Revenue streams:

Type:	A	B	C	D	E
Proportion of population: (p)	0.1	0.2	0.3	0.3	0.1
Average revenues (R):	-100	0	50	100	200

Expected profits per worker without screening/testing

E(revenues/worker) will be

- $= \Sigma p_i R_i$
- = 0.1(-100)+0.2(0)+0.3(50)+0.3(100)+0.1(200)
- = $55

Expected profits per worker will be expected revenues per worker minus costs per worker

- E(π/worker) = E(revenues/worker) - $40 = $15.

- Note: Workers *do not* have outside options equal to their productivity in this model: everybody would earn $40 elsewhere

Screening

- Now, what if could test each worker for $1 and learn which type they were? What proportion of workers would you hire and what would expected profit per worker HIRED be?
- Because wage = $40, firms do not want to hire A and B types. We will therefore on average hire 0.7, or 70% of the workers we test.

What about expected π/(worker hired)?

- On average hire only 70% of interviewees
- Firm's goal is to maximize expected profits of workforce

- If we tested 10 applicants on average we would hire 7 of them.
- Total E(π) = 10 tested workers * (E(π/tested worker) = 10($36) = $360
- Divide this overall profit by the number of workers we will hire on average:
- E(π/worker hired) = $360/7 = $51.43

What about expected π/(worker hired)?

Could also do the preceding in one step:

E(π/worker hired)=
E(π/worker tested)*(# tested/# hired)

(like unit conversion in chemistry)

Equivalent to dividing by (# hired/#tested), or dividing by 0.7 (proportion of applicants hired) in the last example

A Commercial Banking Example of the Value of Screening

- Pay $40 per year.
- Assume can hire any # of workers, so max π/worker.
- Revenue streams:

Type:	A	B	C	D	E
Proportion of population: (p)	0.1	0.2	0.3	0.3	0.1
Average revenues (R):	35	50	60	70	90

Expected profits per worker with and without testing

Without screening:
E(π/worker) = $21.5

Now consider possibility of a screen that identifies A types. Cost of screen is $5 per worker tested.

With screening:
Reject A types.

E(π/worker tested)=$17
E(π/worker hired)=$17*(10/9)=$18.9

Expected profits per worker with and without testing

The differences in the two preceding examples were:

- Smaller proportion of rejected applicants in the commercial bank example than in the investment bank example
- The rejected applicants were less costly overall for the commercial bank than investment bank
- The screening test cost more to administer in the commercial bank example than investment bank example

General Lessons on When Worthwhile to Screen Applicants

- 1) If screening costs small
- 2) If large variations in worker ability
  - Specifically if the low productivity types are very costly to the firm when they are hired, so that firm can save a lot by rejecting worst candidates
- 3) If % of applicants who are highly unproductive is large
  - If the test rejects a lot of applicants
  - Example of points 2 and 3: What is relative spending firms probably do screen applicants for job as dishwasher or for anesthesiologists?

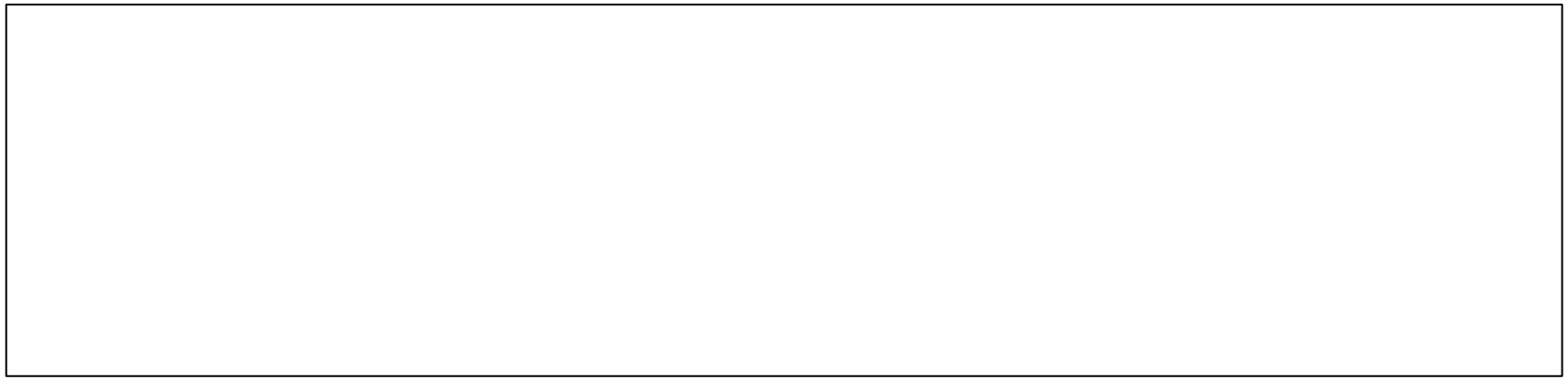
Screening: Formal Model of Screening (Appendix to Ch.2 , p 43)

- Two types of applicants, E and D
- $Q_E > Q_D$
- Productivity is Q; E types are more productive than D types so $Q_E > Q_D$
- p ~ probability that a random job applicant is E type
- 1-p ~ probability that a random job applicant is D type
- Firm pays wage W to every hire , an average of the productivities , so $Q_E > W > Q_D$ (losing money from D types, making money from E types)
- Test/screen available at a cost of S per worker tested
  - Note: Textbook also has q for variability in the accuracy of the test, for simplicity we assume the test is perfectly accurate for now (q=1)

Screening: Formal Model of Screening (Appendix to Ch.2 , p 43)

- Expected profits from hiring randomly
- = $p(Q_E-w)+(1-p)(Q_D-w)$

- Expected profits from hiring from screening (will not hire D types, though we still have to pay for screening them)



Screening: Formal Model of Screening (Appendix to Ch.2 , p 43)

- Change in profit from screening compared to not screening
- $=p(Q_E-w)-s-[\ p(Q_E-w)+(1-p)(Q_D-w)\ ]$
- $=-s-(1-p)(Q_D-w)$
- Recall that by assumption $Q_D-w<0$ by the assumption $Q_D<w<Q_E$

- Can see how change in profit from screening ("returns to screening") changes when p and s change

$$\frac{\partial \Delta\pi}{\partial p}<0 \qquad \frac{\partial \Delta\pi}{\partial s}<0$$

Screening: Formal Model of Screening (Appendix to Ch.2 , p 43)

- Signs on partial derivatives tell us that it is more worthwhile (higher "return to screening") when

- p is low (so 1-p is high, i.e. large proportion of low-productivity types)
- s is low (when costs of screening are low)

$$\frac{\partial \Delta\pi}{\partial p} < 0 \qquad \frac{\partial \Delta\pi}{\partial s} < 0$$

Screening in Practice

- Temporary help agencies (temp agencies) act as intermediary between workers and firms that need temporary help.
  - Provides firms with explicit trial period without obligation
    - If firm wants to keep worker, they can't just "poach" him or her – must pay a fee to temp agency
    - This trial period is like a big screen
- Often when workers apply for jobs, they are subject to various written tests of ability, or several rounds of interviews
  - These are examples of firm screening

Probation Wage Model

- If you cannot observe a worker's true productivity before hiring them, but you can after they work for you one period and subsequently fire them if they are unproductive, then you can:
  - Use low initial wage to keep low-productivity workers away
  - Offer big raise to those who are not fired after first period (to attract productive workers)

Model of Probation Wage

- Assume:
  - 2 periods, interest rate=0.
  - Unskilled wage (outside option) is W_U
  - Skilled wage (outside option) is $W_S = W_U + G$
  - Your firm pays W_1 in period 1, W_2 in period 2
  - How do you choose W_1 and W_2?
- Goal 1: Attract skilled
  - Must offer SUM over 2 periods that at least matches what skilled worker could get elsewhere:
  - $W_1+W_2>=2W_S$
  - For profit maximization set $W_1+W_2=2W_S$
- Goal 2: Repel Unskilled
  - $W_1+W_U<2W_U$
  - $W_1<=W_U$
  - For simplicity $W_1=W_U$

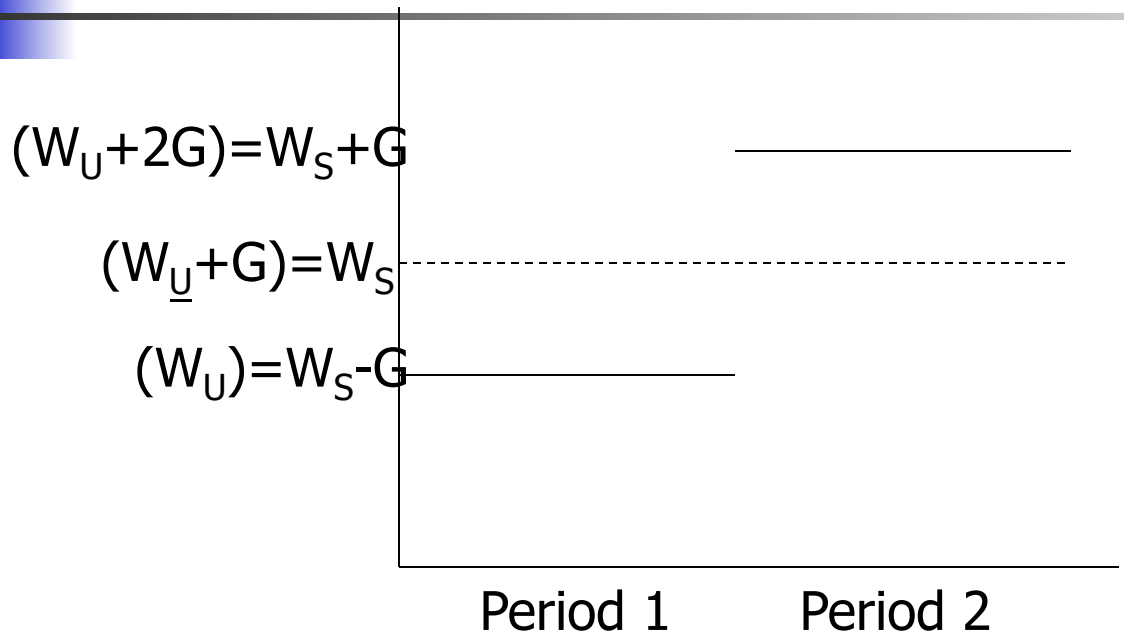
Optimal Strategy

- Goal 1: Attract skilled
  - Must offer SUM over 2 periods that at least matches what skilled worker could get elsewhere:
  - $W_1+W_2>=2W_S$
  - For profit maximization set
    $W_1+W_2=2W_S$
- Goal 2: Repel Unskilled
  - $W_1<=W_U$
  - For simplicity: **$W_1=W_U$**

- Just substitute in:
  - $W_1+W_2=2W_S$
  - $W_U+W_2=2W_S$
  - $W_2=2W_s-W_u$
  - $W_2=2(W_u+G) - W_u$
  - **$W_2=W_u+2G$**

- Notice: As premium G earned by skilled workers in the general market rises, the gap between period 1 and period 2 wage must rise.

Graphical Representation



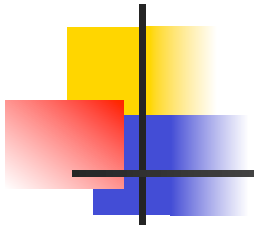
- In practice, could offer:
  - $W_1=W_U$ - a small amount
  - $W_2=W_u+2G$ + small amount

Probation Wage Extension

When There is a Possibility of Not Detecting Unskilled Workers

- Assume:
  - 2 periods, interest rate=0.
  - Unskilled wage (outside option) is W_U
  - Skilled wage (outside option) is $W_S = W_U + G$
  - P is probability of unskilled worker NOT being detected and staying on at your firm
  - 1-P is probability of unskilled worker being detected and fired after one year

Probation Model Extension



- Assume P =prob unskilled worker doesn't get detected
- Implies (1-P)=prob unskilled worker DOES get detected, and therefore fired from your firm
- Goal 1: Attract skilled
  - $W_1+W_2=2W_S$
- Goal 2: Repel Unskilled
  - $W_1+PW_2 + (1-P)\ W_U<=2W_U$

Probation Model Extension

- Goal 1: Attract skilled
  - $W_1+W_2=2W_S$
- Goal 2: Repel Unskilled
  - $W_1+PW_2 + (1-P)\ W_U<=2W_U$

- Solution:
- $W_2 = W_U + 2G/(1-P)$
- $W_1 = W_U – 2GP/(1-P)$

- Lesson:
- So $dW_2/dP > 0$

- Must increase W_2 if P increases.
- Intuition: unskilled workers now are sometimes eligible for W_2. We must then decrease the $W_1$the wage they receive for sure at our firm.

Proof

- To attract skilled workers, must meet or beat his/her best alternative:
- $W_1 + W_2 >= 2W_S = 2(W_U + G)$ (1)
- To deter unskilled workers from applying, his/her expected earnings at firm must be less than or equal to best alternative:
- $W_1 + P*W_2 + (1-P)W_U <= 2W_U$ (2)

- 2 equations, 2 unknowns. One solution method: assume that (1) holds with equality due to cost minimization. The subtract (1) from (2) to remove W_1.
- $(P-1)*W_2 + (1-P)W_U <= 2W_U - 2(W_U + G)$
- Re-arranging,
- $(1-P)W_U + 2G <= (1-P)*W_2$ or
- $W_2 >= W_U + 2G/(1-P)$
- To minimize costs, set W_2 to the minimum above:
- $W_2 = W_U + 2G/(1-P)$

Proof (continued)

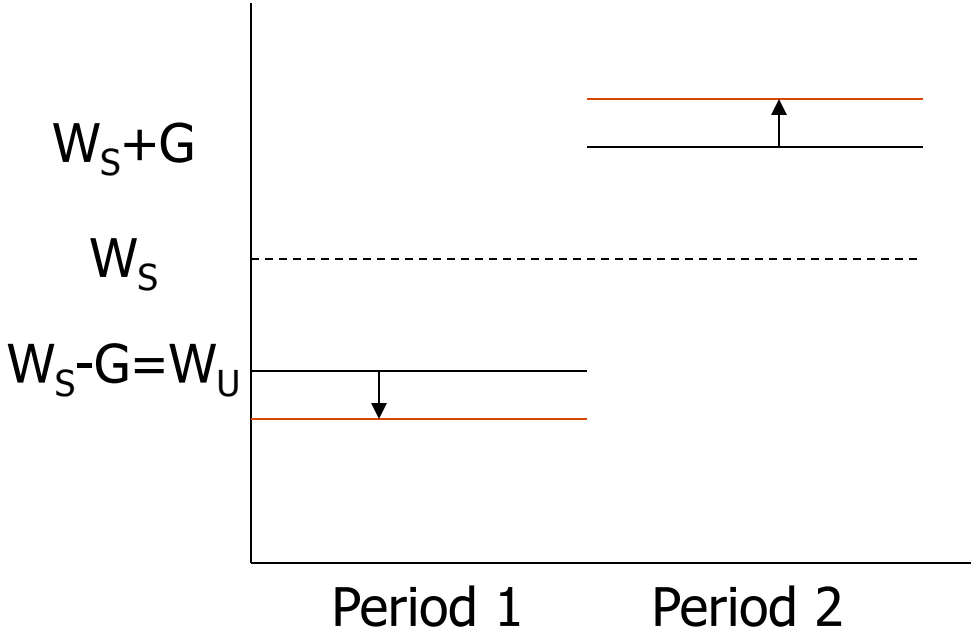
- We have $W_2 = W_U + 2G/(1-P)$
- Substitute into (1) (expressed as an equality) to get
- $W_1 = W_U - 2GP/(1-P)$

- So $dW_2/dP = 2G/(1-P)^2 > 0$ and opposite and equal for W_1.

- What about as gap in wages between unskilled and skilled, G, increases in rest of labor market?

Probation Wage: Check your Understanding

- I am hiring workers. I'm paying a probation wage in the first period. I want only skilled workers to apply, but I'm still getting some unskilled workers.
- Should I pay a lower probation or higher probation wage?



Signaling: Motivating question

- If you had to choose, which would you rather have?
  - A. All the knowledge you gained in college, but **no college degree**
  - B. The college degree, but **none of the knowledge** you gained

Education credential as signal

- Mechanism:
  - Find an observable trait tied to productivity, e.g. education
  - Credential (or 'signal') should be harder for low-productivity workers to acquire

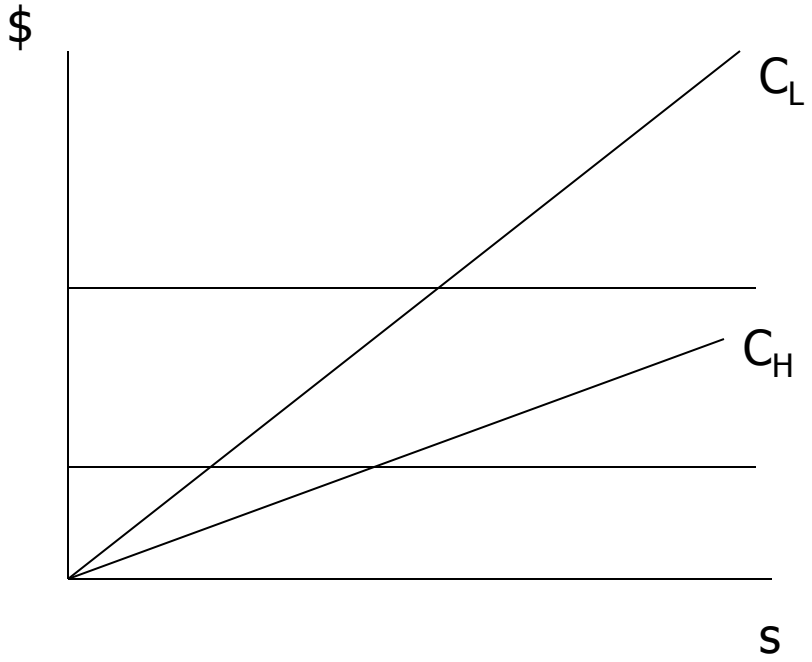
Spence Signaling Model

- 2 ability types, high and low.
  - $VMP_{hi} > VMP_{lo}$
- Asymmetric information
  - Firms don't know ability type, workers know their type
- More able workers have lower costs of schooling
  - Lower effort costs, enjoy school more, finish a degree in fewer years, have more time for work or other things, earn scholarships

Spence Signaling Equilibrium - Graphically

- Firms
  - Pay w1=VMP_H to those who get s* yrs of schooling
  - Pay w0=VMP_L to those who don't
- Workers
  - Get s* yrs if payoff from getting s* yrs is greater than payoff from getting 0 yrs
  - Will not get any amount of schooling other than 0 or s* yrs in this model because there are no returns to getting anything between 0 and s*, and no returns to getting any education beyond s*

- $C_H < C_L$
- VMP_H=Prod of high types
- VMP_L=Prod of low types

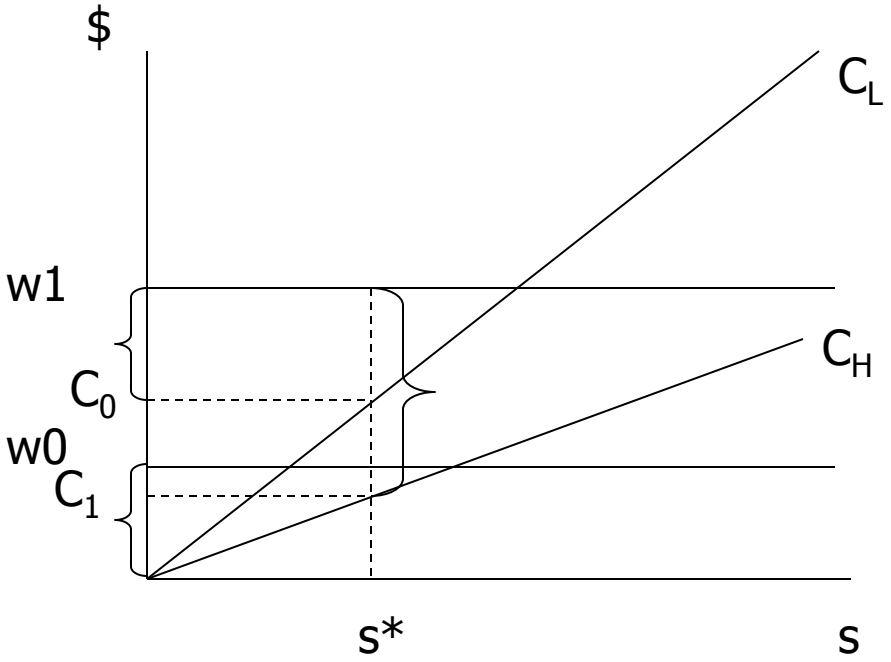


Spence Signaling Equilibrium - Graphically

- Why does s* work?
- This is called a "separating equilibrium".

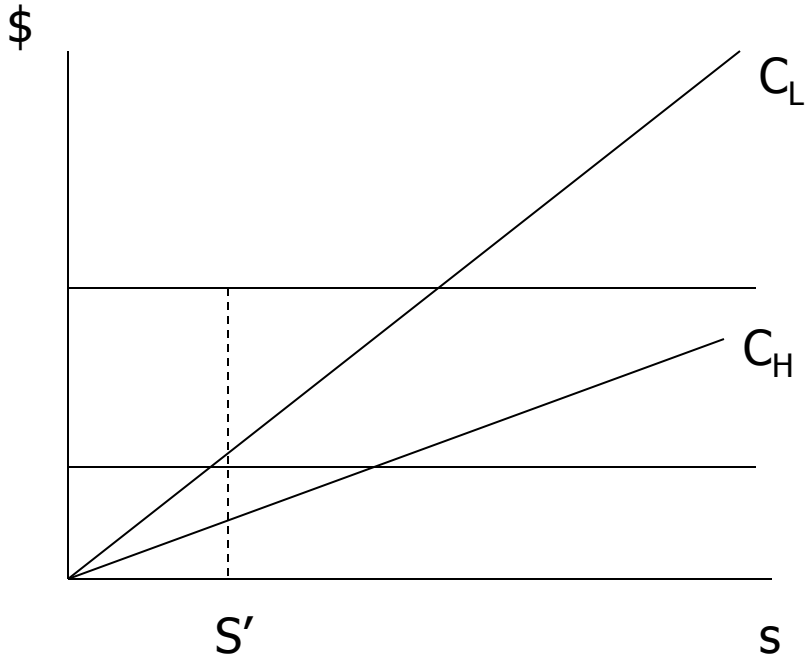
- Low types get
  - w0 if no schooling
  - w1-C_0 if s* years
  - Suppose w0>w1-C_0
  - Deters low skill types from s* yrs (degree)

- High types get
  - w0 if no schooling
  - w1-C_1 if s* years
  - w1-C_1>w0
  - So high types get s* yrs



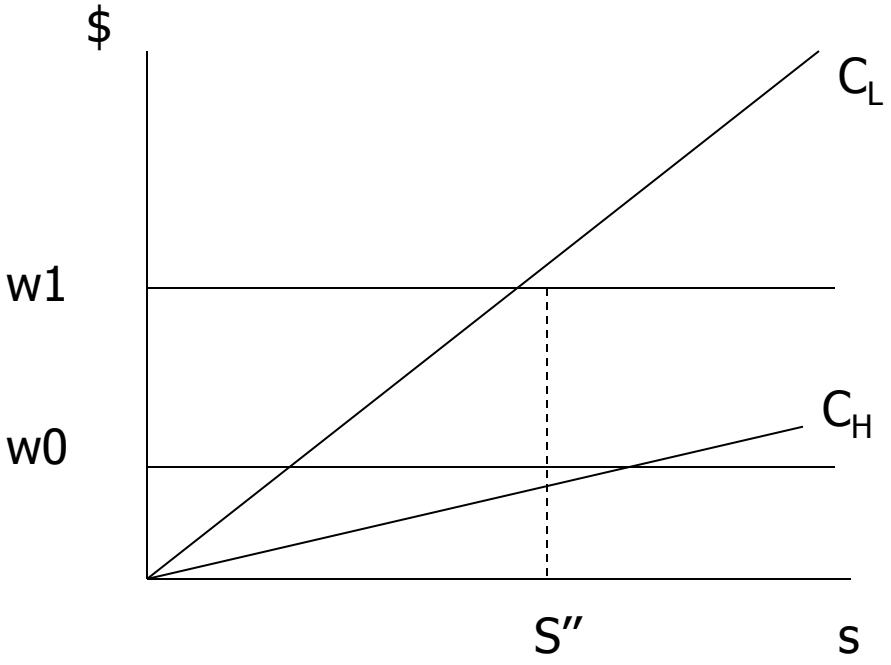
Spence Signaling Equilibrium - Graphically

- What if s' chosen as cut-off by firms?
- Do low types choose to get s' years of schooling?
- Yes, because get more utility than from w0
  - Effort cost not high enough to deter them
- Firm would end up paying low types w1
  - But their prod is VMP_L
  - Firm loses money, goes out of business



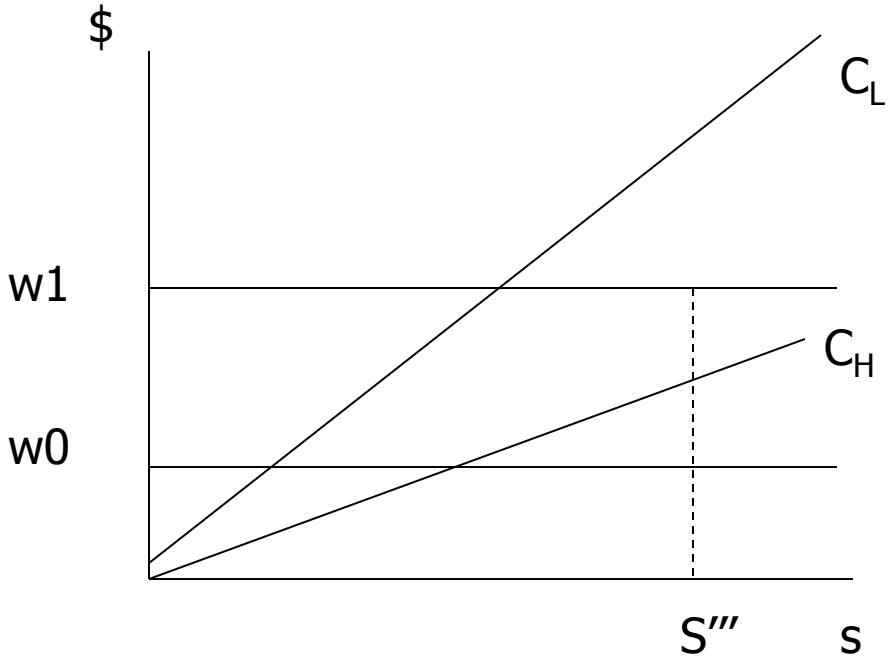
Spence Signaling Equilibrium - Graphically

- What if s" is chosen as cut-off by firms?
- Do low types choose to get s" years of schooling?
- No -- get more utility from w0.
- Do high types get s" years of schooling?
- Yes -- get more utility from (w1-cost of schooling).
- **Many equilibria exist**
- S* was the lowest s that still resulted in a separating equilibrium



Spence Signaling Equilibrium - Graphically

- What if s‴ is chosen as cut-off by firms?
- Do low types choose to get s‴ years of schooling?
- No, because get more utility from w0
- Do high types s‴ years of schooling?
- No, because get more utility from w0
- **Nobody gets schooling**
- "Pooling Equilibrium"



Empirical Evidence

- Wolpin – Self-employed get just as much education as employees
  - Argues irrational to do so unless it increases productivity. So education must increase productivity
- Weiss – Studied one factory and found that dropouts and high school graduates equally productive, but latter had higher job attendance and lower quit rates
  - Does more education signal more tenacity?

Empirical Evidence (continued)

- Altonji – One additional year of high school increases wages about 7% but the impact of all the courses taken during the year (e.g. 2 math courses, 1 science course) increases earnings by only 1-2%
  - Is the rest signaling ability?
- Rose and Betts – found that can explain the 7% return to a year of high school once one disaggregates math courses into *types* of math courses etc.

2) If education just a signal of ability, should firms pay more to workers with more education?

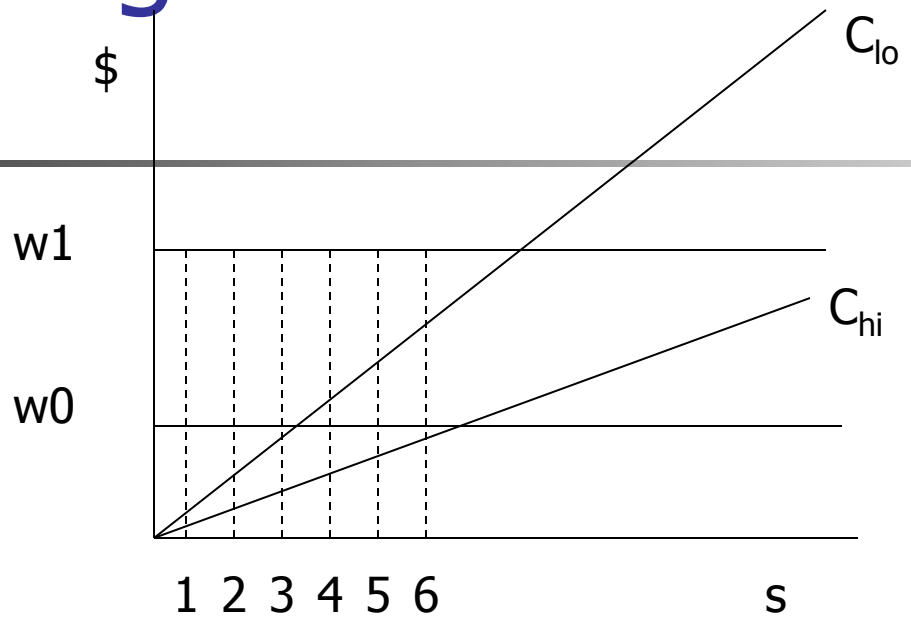
- If more educated are more productive, then yes.
- Firm doesn't care whether education increases production or merely sorts people by productivity
- Only time firm won't pay for more education is if education is only a signal, and firms can learn ability of workers quite quickly
  - Some research by Altonji and Pierret suggests firms do learn ability in roughly two years

When is education more likely to raise prod'y?

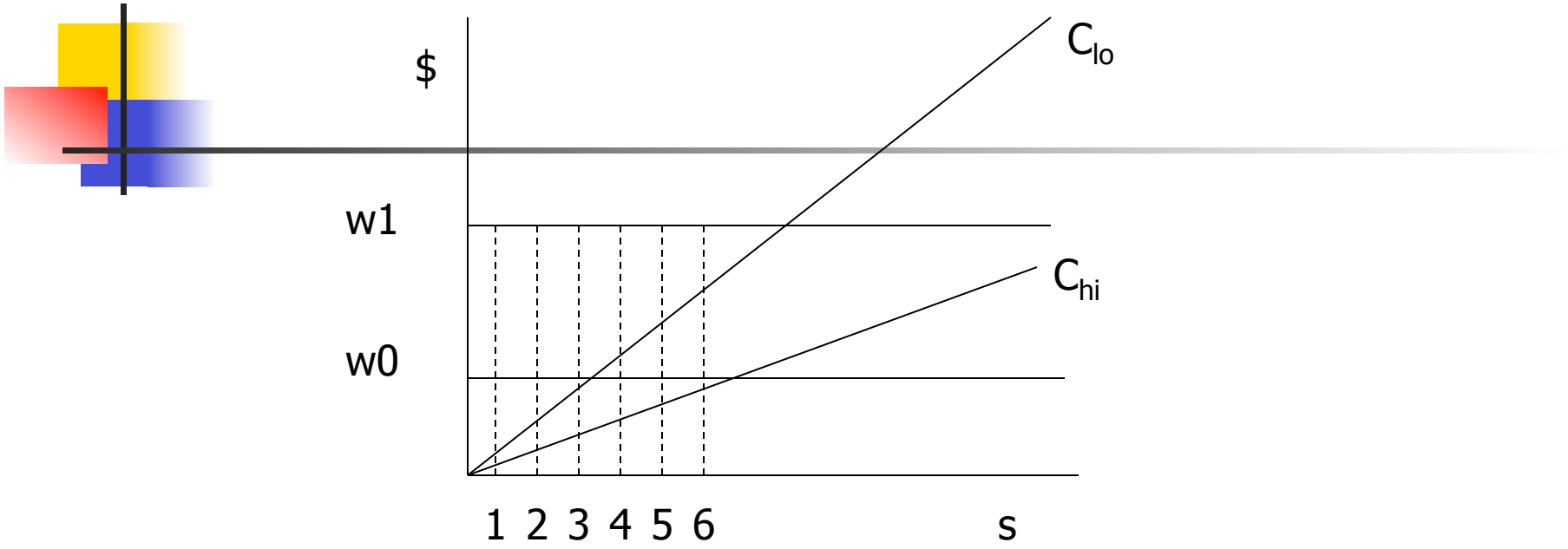
- When specific skills taught map closely and very directly to skills used on the job

- Engineering
- Medicine
- Law

Signaling Review



1. Would low types be willing to obtain s*=1 years of schooling?
2. Would high types be willing to obtain s*=1 years of schooling?
3. Would low types be willing to obtain s*=6 years of schooling?
4. Would high types be willing to obtain s*=6 years of schooling?



How many years of schooling should firms require for the high wage job?

Sample Problems from 2000 test #1

- 1. (25 points) Suppose that there are two types of workers, skilled and unskilled, with productivities of $2 and $4 per period. (These numbers equal productivity of the two types of workers at both your firm and other firms.) Each worker will work for your firm for 1 or 2 periods. You learn the worker's productivity at the end of period 1. Each worker makes up 50% of the population.
- a) Your Vice President Finance suggests offering an average salary of $3 per period, on the logic that average productivity of workers in the population is $3. Who will the firm end up hiring in period 1? What are the profits that will result? Should you support your Vice President's suggestion? (15 points)

Sample Problems from 2000 test #1

b) Outline how you might set up a probationary period in order to obtain only the more productive workers. Be specific and explain how it works. (10 points)

Sample Problems from 2000 test #1

2. (35 points) You must decide whether to hire another secretary, whose output is easily measured, or merely to install Voice Processor (VP), which is a new and extremely reliable voice recognition program, and employ existing secretaries. A secretary costs $800 per month and VP, which can only be rented, costs $500 per month. VP yields 6000 pages of output per year.

- **The firm is planning to stay in business for only 12 more months. This applies to both questions a) and b).**
- a) If a new secretary produces twice as much output (correctly typed pages) as VP, should the firm hire the secretary or rent Voice Processor? (15 points)

Sample Problems from 2000 test #1

b) Now suppose that half of the secretaries are twice as productive as VP, but the other half are only equally productive. Suppose that the firm can determine worker productivity only at the end of 9 months. At that time, it can fire unproductive workers (but won't hire a new secretary for the final 3 months). Will the firm prefer to hire a secretary instead of renting VP?

- Hint: What is the expected cost and output per year from hiring a secretary and from renting VP? (20 points)