HUMAN CAPITAL

EE 471

Introduction

- People bring into the labor market a unique set of abilities and acquired skills known as human capital.
- Workers add to their stock of human capital throughout their lives, especially via job experience and education.

- Why some workers obtain a lot of schooling and other workers drop out at the early age?

- How does the rate of return to schooling compare with the rate of return on other investments?

- What is Human capital?
  - Education level
  - Formal and Informal On the job training programs

- We will assume that worker chooses the level of human capital investments that maximizes the present value of lifetime earnings

Education in the Labor Market: Some Stylized Facts

- Education is strongly correlated with:
  - Labor force participation rates
  - Unemployment rates
  - Earnings

Present Value

$$PV = \frac{y}{(1+r)^t}$$

r is the rate of interest (rate of discount)

PV tells us how much needs to be invested today in order to have y dollars next year or

A future payment of y dollars is discounted to make it comparable to current dollars.

Suppose someone gives you a choice between two offers:

You can have either $100 today or $100 next year. Which offer would you take?

Assuming that the rate of interest is 5%.

If you receive $100 today, you can invest it, and you will then have $100 × (1 + 0.05) dollars next year (or $105).

Moreover, that receiving $95.24 today (or $\frac{100}{1+0.05} = \frac{100}{1.05}$) would be worth $100 next year. Hence the PV of receiving $100 next year is only $95.24. //

The Schooling model

- Education is associated with lower unemployment rates and higher earnings.
- What factors motivate some workers to get professional degrees while other workers drop out before they finish high school?
- Assume that workers acquire the education level that maximizes the present value of lifetime earnings

Consider the situation faced by an 18-year old man who just received his high school diploma and who is contemplating whether to enter labor market or attend college and delay labor market entry by an additional four years

Suppose that there is no on-the-job training and the skills learned in school do not depreciate over time.

These assumption imply that the worker's productivity does not change once he leaves school, so that real earnings are constant over the life cycle

Going to college involves two different types of costs

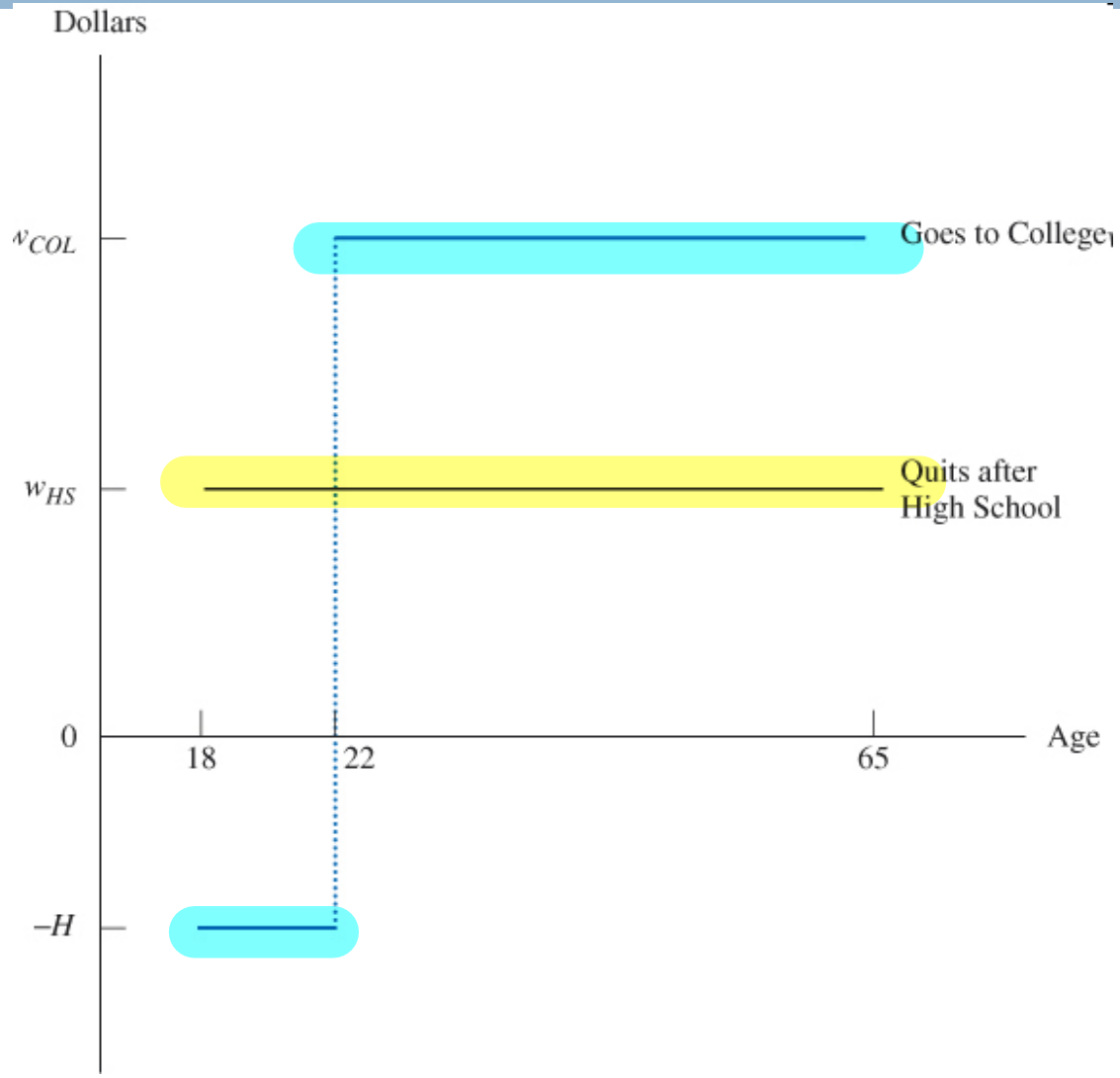
→ A year spent in college is a year spent out of the labor force, so that a college education forces the worker to forgo some earnings

"opportunity cost of going to school"

The opportunity cost is W_{HS} dollars for each year the student goes to college

→ Out of pocket expenses of H dollars for tuition, books and a variety of other fees.

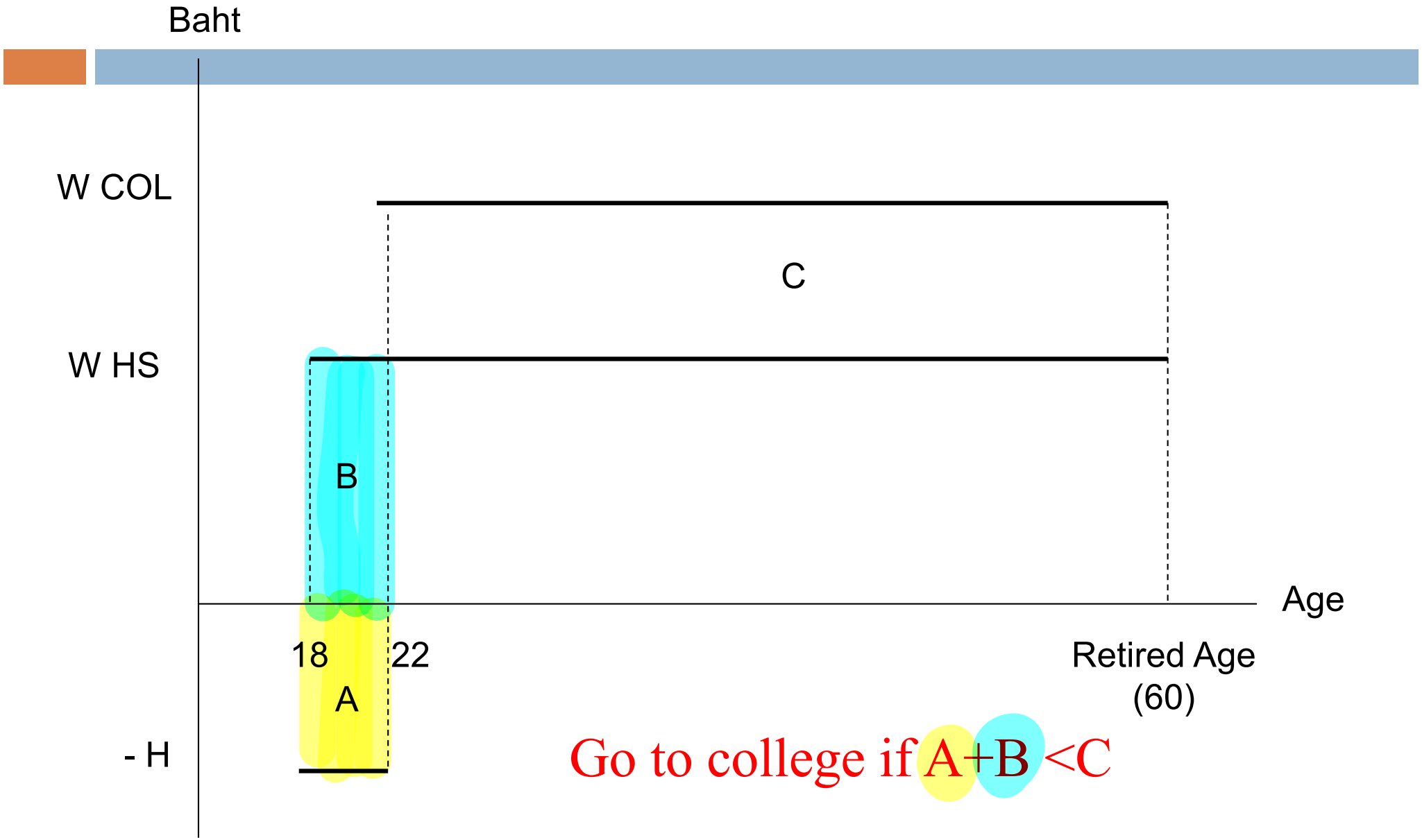
Potential Earnings Streams Faced by a High School Graduate



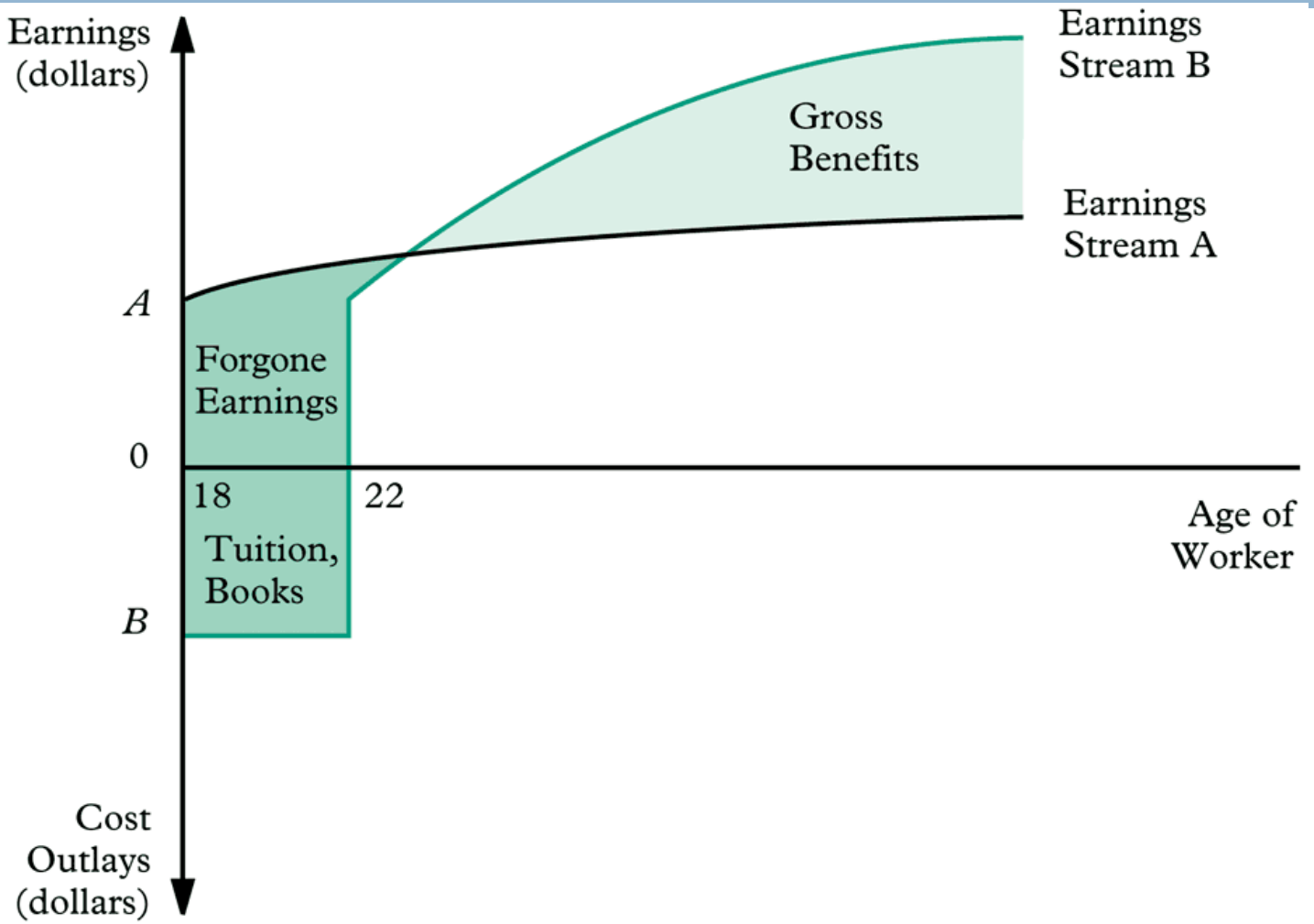
College has no intrinsic value to the student, employers who wish to attract a highly educated (and presumably more productive) worker will have to offer higher wages, so that $W_{COL} > W_{HS}$.

The higher wage paid to workers with more schooling is a compensating differential that compensates workers for their training costs.

Age – Earning profile (Mincer, 1974)



Schooling Model



Present Value of Age-Earnings Profiles

- High School

$$PV_{HS} = W_{HS} + \frac{W_{HS}}{(1+r)} + \frac{W_{HS}}{(1+r)^2} + \ldots + \frac{W_{HS}}{(1+r)^{46}}$$

(1)

- College

(2)

$$PV_{COL} = \underbrace{-H - \frac{H}{(1+r)^1} - \frac{H}{(1+r)^2} - \frac{H}{(1+r)^3}}_{\text{Direct Costs of Attending College}} + \underbrace{\frac{w_{COL}}{(1+r)^4} + \frac{w_{COL}}{(1+r)^5} + \ldots + \frac{w_{COL}}{(1+r)^{46}}}_{\text{Post-college earnings stream}}$$

r gives the worker's rate of discount.

There are 47 terms in this sum, one term for each year that elapses between the ages of 18 and 64.

A person's schooling decision maximizes the present value of lifetime earnings.

The worker attends college if the present value of lifetime earnings when he gets a college education exceeds the present value of lifetime earnings when he gets only a high school diploma

$$PV_{COL} > PV_{HS}$$

Example

Suppose a worker lives only two periods and chooses from two schooling options. He can choose not to attend school at all, in which case he would earn $20,000 in each period. The present value of earnings is

$$PV_0 = 20,000 + \frac{20,000}{(1+r)}$$

He also can choose to attend school in the first period, incur $5,000 worth of direct schooling costs, and enter the labor market in the second period, earning $47,500. The present value of this earnings stream is

$$PV_1 = -5,000 + \frac{47,500}{(1+r)}$$

Suppose that the rate of discount is 5 percent

$$PV_0 = 20,000 + \frac{20,000}{(1+0.05)} = \$39,048$$

$$PV_1 = -5,000 + \frac{47,500}{(1+0.05)} = \$40,238$$

The worker chooses to attend school.

Suppose that the rate of discount is 15 percent

$$PV_0 = 20,000 + \frac{20,000}{(1+0.15)} = \$37,391$$

$$PV_1 = -5,000 + \frac{47,500}{(1+0.15)} = \$36,304$$

The worker would not go to school.

- The rate of discount r plays a crucial role in determining whether a person goes to school or not.
- The higher the rate of discount, the less likely a worker will invest in education.
- A worker who has a high discount rate attaches a very low value to future earnings opportunities.

- Real earnings (earnings adjusted for inflation).
- Age-earnings profile: the wage profile over a worker's lifespan.
- The higher the discount rate, the less likely someone will invest in education (since they are less future oriented).
- The discount rate depends on:
  - the market rate of interest.
  - time preferences: how a person feels about giving up today's consumption in return for future rewards.

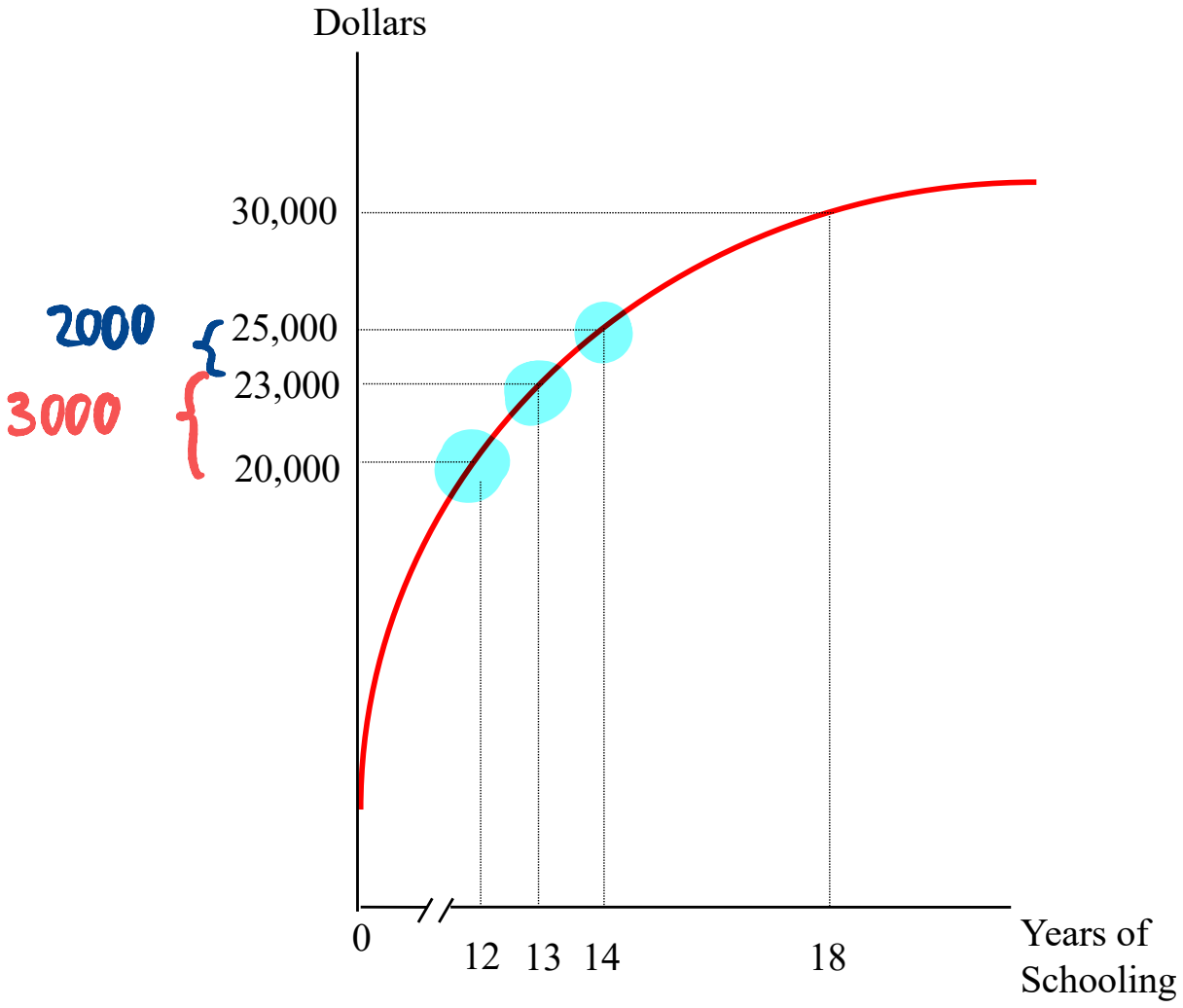
The Wage-Schooling Locus

- The salaries firms are willing to pay workers depends on the level of schooling.

"Stopping rule" → tells us when it is optimal to quit school and enter the labor mkt.

Consider a labor mkt where a worker's productivity depends only on how much education he has.

The Wage-Schooling Locus



The marginal rate of return to schooling

E.g. the first year of college increases annual earnings in the post school period by $3000.

The percentage change in earnings from getting this additional year of school is

$$\frac{3000}{20000} \times 100 = 15\%$$

The worker gets a 15 percent wage increase from staying in school and attending that first year of college

We refer to this percentage change in earnings resulting from one more year of school as the marginal rate of return to schooling (MRR)

The MRR to schooling must decline as a person gets more schooling

Example, the MRR to second year of college is only 8.7%.

$$\frac{2000}{23000} \times 100 = 8.7\%$$

Three important properties

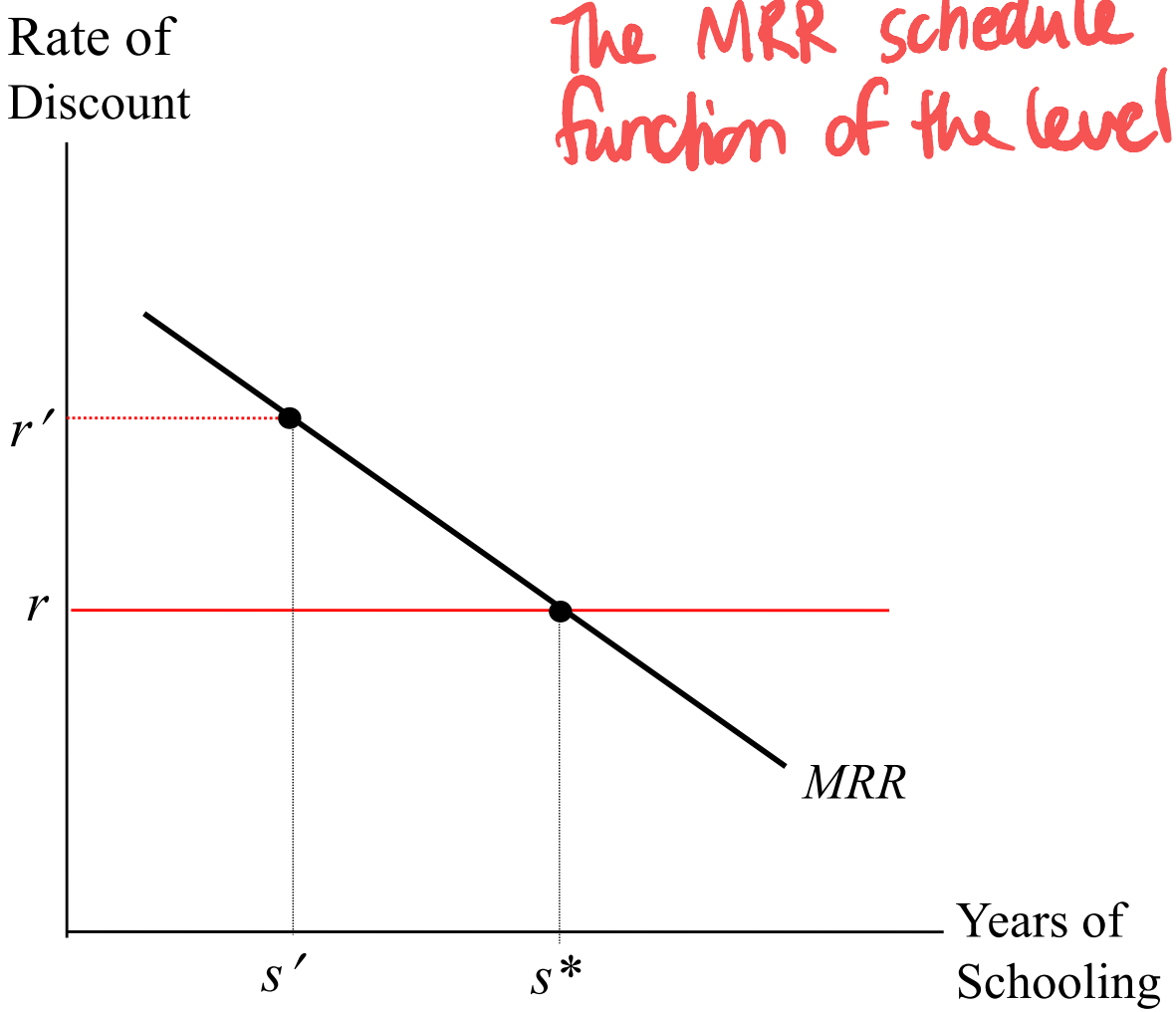
1. Upward sloping
2. The slope of the wage-schooling locus tells us by how much a worker's earnings would increase if he were to obtain one more year of schooling
3. Concave- The monetary gain from each additional year of schooling declines as more schooling is acquired. (Law of diminishing returns also applies to human capital accumulation)

The Marginal Rate of Return (MRR) to Schooling

- The slope of the wage-schooling locus tells us by how much earnings increase if the person stays in school one more year
- The percentage change in earnings resulting from one more year of school as **the marginal rate of return to schooling**
- The marginal rate of return to schooling **must decline** as a person gets more schooling

$$\Delta w / \Delta s$$

The schooling decision



The MRR schedule is a declining function of the level of schooling.

The stopping rule, or when should I quit school?

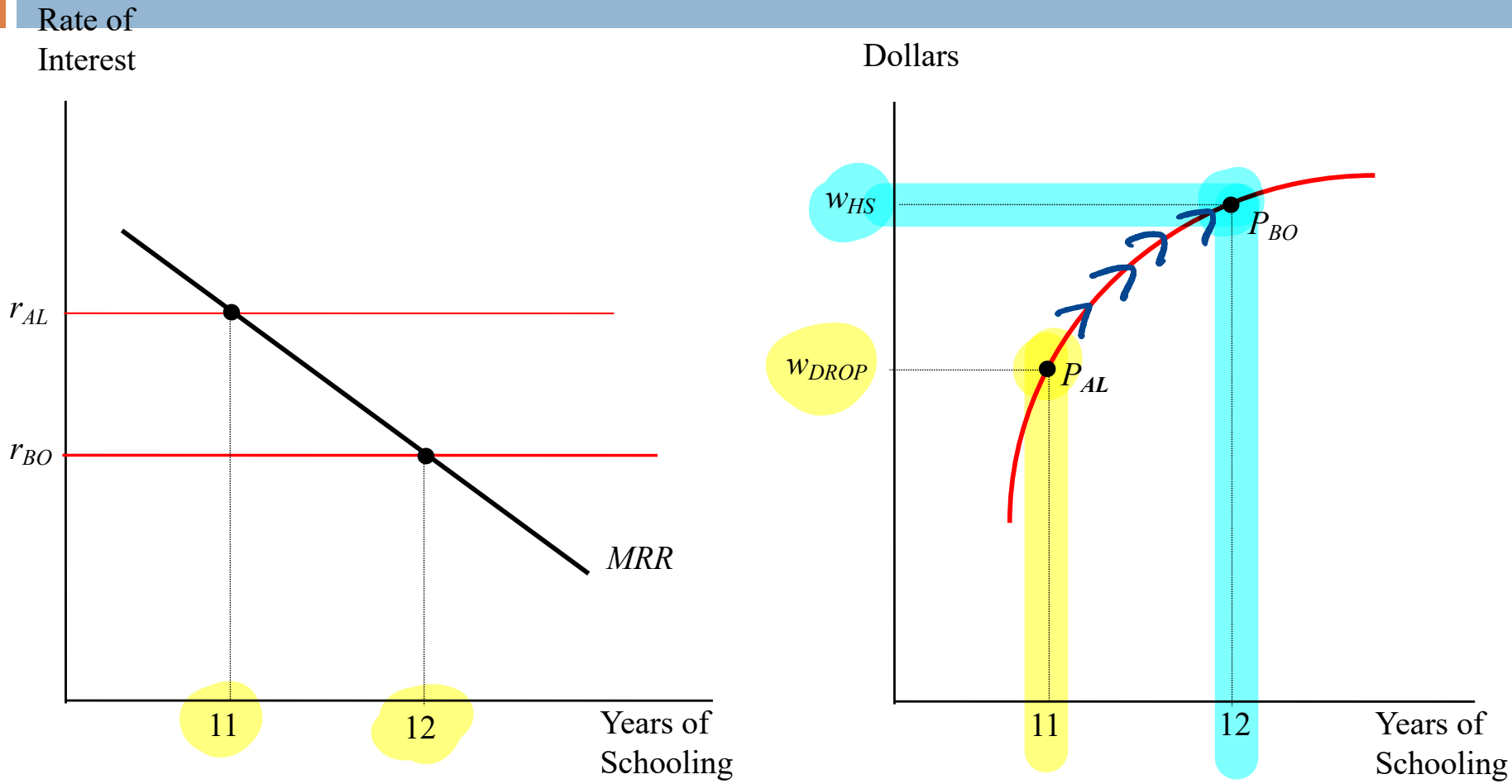
Stop schooling when the marginal rate of return to schooling = r

This stopping rule maximizes the worker's PV of earnings over the life cycle ~

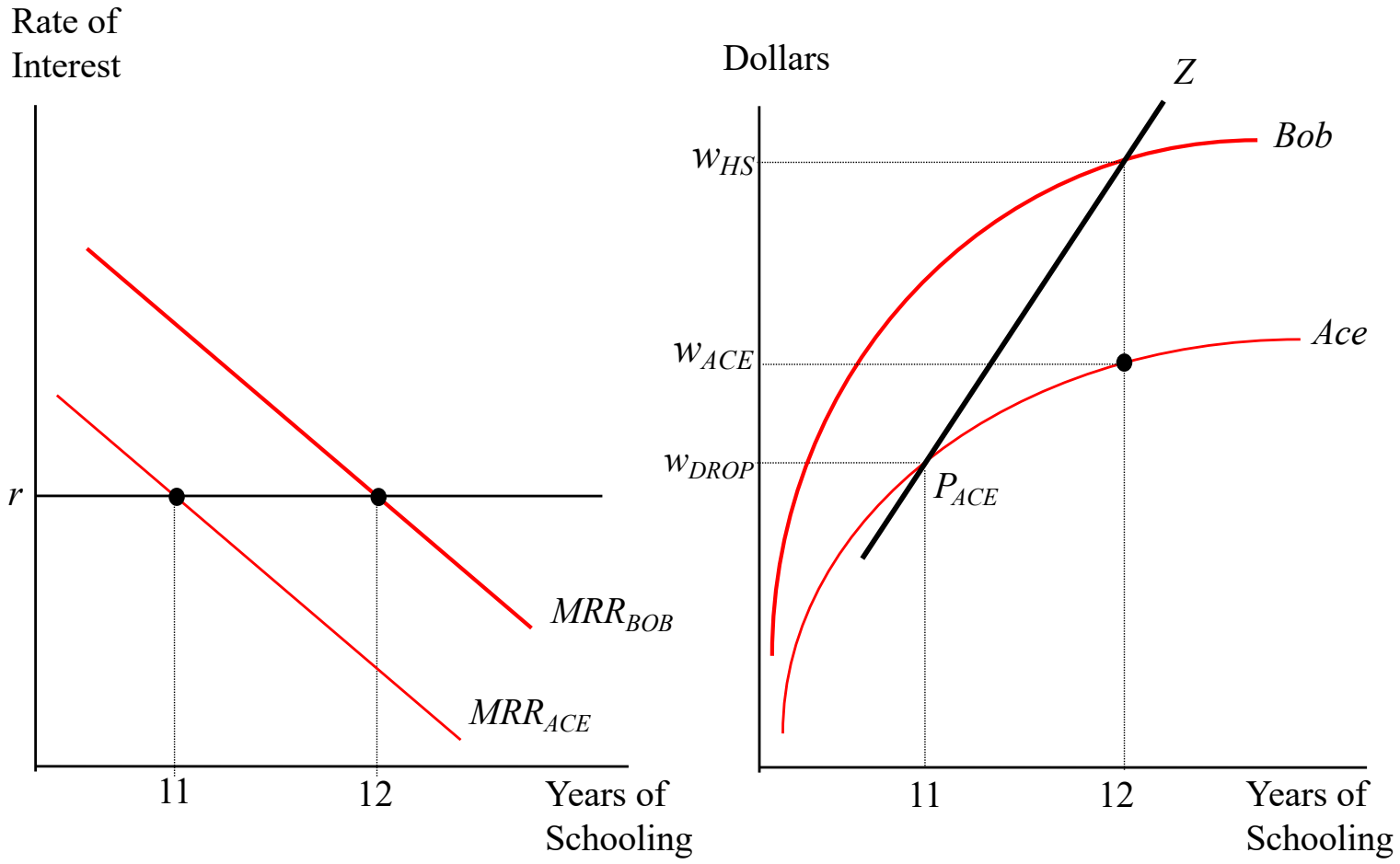
Education and Earnings

- Differences in the Rate of Discount
- Differences in Ability

Schooling and earnings when workers have different rates of discount



Schooling and Earnings when Workers have different abilities



$\ln W_i = \beta_1 + \beta_2 \text{Schooling} + \beta_2 X_3 \ldots + u_i$

- Observed data on earnings and schooling does not allow us to estimate returns to schooling.
- In theory, a more able person gets more from an additional year of education.
- Ability bias: The extent to which unobserved ability differences exist affects estimates on returns to schooling, since the ability difference may be the true source of the wage differential.

Estimation the Rate of Return to Schooling

- Estimation Model

$$\log w = \beta S_i + Other\ Variables$$

Semi log model

$$\ln Y_i = \beta_1 + \beta_2 X_i$$

$$\frac{1}{Y}\frac{dY}{dX} = \beta_2$$

$$\beta_2 = \frac{dY/Y}{dX}$$

Semielasticity of Y with respect to X

$100 \times \beta_2$ is known as the semielasticity of Y with respect to X.

Some Evidence

- In studies of twins, presumably holding ability constant, valid estimates of rate of return to schooling can be estimated.
  - Estimates range from 3% to 15% annual return to a year of education.

- Generally, the rate of return to schooling is higher for workers who were born in states with well-funded education systems.

$$\Delta \log w_j = \beta \Delta S_j + \text{other variables.}$$

Does student achievement or their eventual labor mkt performance improve because of increases in teacher salaries or reductions in the pupil/teacher ratio?

Policy Application: School Quality and Earnings

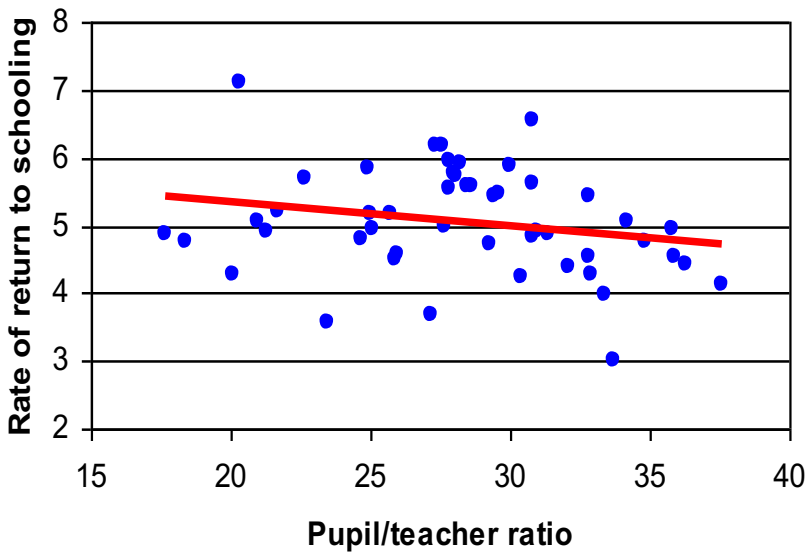
- David Card and Alan Krueger (1992) show that
  - school quality is positively correlated with the rate of return to schooling
  - the rate of return to schooling is negatively correlated with the state's pupil/teacher ratio

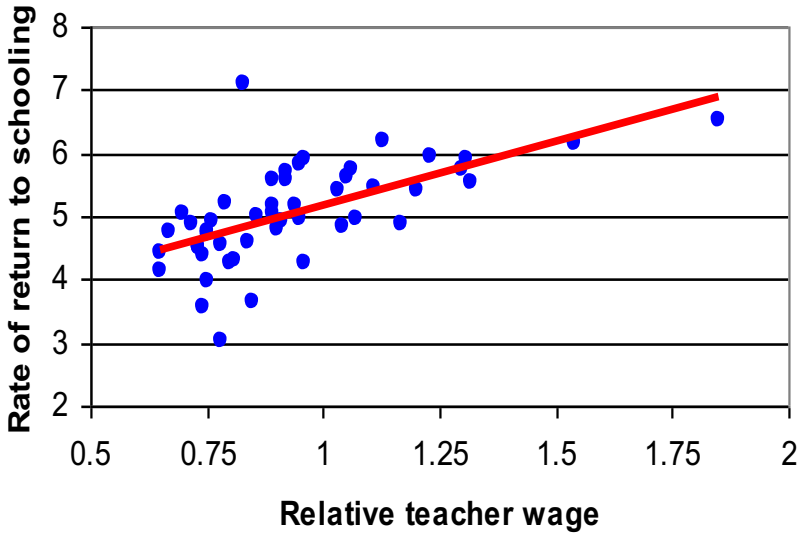
- Data on worker earnings from 1980 census to calculate the rates of return to schooling to cohorts of workers born in a particular state

Education production function

$$Y = f(x_1, x_2, x_3, \ldots)$$

School Quality and the Rate of Return to Schooling





Source: David Card and Alan B. Krueger, "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States," *Journal of Political Economy* 100 (February 1992), Tables 1 and 2. The data in the graphs refer to the rate of return to school and the school quality variables for the cohort of persons born in 1920-1929.

- Card and Krueger concluded that children born in states that offered better schools had a substantially higher rate of return to schooling.

- Decreasing the pupil/teacher ratio by 10 students increased the rate of return by about 1 percentage point, whereas increasing the relative wage of teachers by 30 percent increased the rate of return to schooling by 0.3 percentage point.

part II

Do Workers Maximize Lifetime Earnings?

- The schooling model assumes that workers select their level of education to maximize the present value of lifetime earnings.

- To test this hypothesis directly, we must observe the age-earnings profile at two points in time.
  - Unfortunately, once a choice is made, we cannot observe the earnings associated with the non-choice.
  - Thus, using the observed wage differential to determine if the worker selected the "right" earnings stream yields meaningless results.

Example

A simple numerical example with two workers, Willie and Wendy. Willie is particularly adept at “blue-collar” work, and this type of work requires no schooling. Wendy is particularly adept at “white-collar” work, and this type of work requires one year of schooling.

Suppose also that there are two periods in the life cycle. If a person does not go to school, he works in the blue-collar job in both periods. If the person goes to school , the person would go to school in the first period and work in the white-collar job in the second period.

The wage-schooling locus for each worker is summarized by these data:

	Earnings in Blue-Collar Job	Earnings in White-Collar Job
Willie	$20,000	$40,000
Wendy	$15,000	$41,000

Suppose that both Willie and Wendy have a discount rate of 10 percent.

$$\textit{Willie's present value if he does not go to school} = 20{,}000 + \frac{20{,}000}{(1+0.10)} = \$38{,}182$$

$$\textit{Willie's present value if he goes to school} = 0 + \frac{40{,}000}{(1+0.10)} = \$36{,}364$$

Willie will decide that he should not go to school and will be a blue-collar worker. The present values of Wendy's potential earnings streams are

$$\textit{Wendy's present value if she does not go to school} = 15{,}000 + \frac{15{,}000}{(1+0.10)} = \$28{,}636$$

$$\textit{Wendy's present value if she goes to school} = 0 + \frac{41{,}000}{(1+0.10)} = \$37{,}273$$

Wendy goes to school in the first period and works in a white-collar job in the second.

We observe the earnings of persons who do not go to school and work in blue-collar jobs (like Willie). The present value of their earnings is $38,182.

We also observe the earnings of persons who do go to school and work in white-collar jobs (like Wendy). The present value of their earnings stream is $37,273.

Self-Selection Bias

- Workers may select themselves into jobs for which they are better suited.
- Therefore, wage differentials may not be associated with education.

Schooling as a Signal

- Education reveals a level of attainment which signals a worker's qualifications or innate ability to potential employers.
- Information that is used to allocate workers in the labor market is called a signal.
- There could be a "separating equilibrium."
  - Low-productivity workers choose not to obtain X years of education, voluntarily signaling their low productivity.
  - High-productivity workers choose to get at least X years of schooling and separate themselves from the pack.

Suppose there are two types of workers in the labor mkt, low productivity workers and high-productivity workers and that the distribution of productivity in the population is given by... → Table on the next page

The productivity differences between the two types of workers exist since birth and have nothing to do with how much schooling a particular worker gets.

Schooling as a Signal

Type of Worker	Proportion of Population	Present Value of Lifetime Productivity
Low-productivity	q	$200,000
High-productivity	1-q	$300,000

The proportion of q is between 0 and 1, the average salary in this "pooled equilibrium" is between $200,000 and $300,000.

Pooling Workers

Because low-productivity workers will always lie about their productivity, the firm will disregard what anyone says about their own qualifications.

The average productivity and salary of the workers hired by the firm is then given by

$$\begin{aligned} Average\ salary &= (200,000 \times q) + \left[300,000 \times (1-q)\right] \\ &= 300,000 - 100,000q \end{aligned}$$

The average salary is simply a weighted average of the workers' productivities, where the weights are the proportions in the population that belong to each productivity group.

Separating Equilibrium.

Suppose a firm chooses the following rule of thumb for allocating workers to the two types of jobs.

If a worker has at least $\overline{y}$ years of college, the firm assumes that the worker is a high-productivity worker, allocates him to a job that requires a high level of skills, and pays him a (life time) salary of $300,000.

If a worker has fewer than $\overline{y}$ years of college, the firm assumes that the worker is a low-productivity worker, allocates him to an unskilled job, and pay him a salary of $200,000.

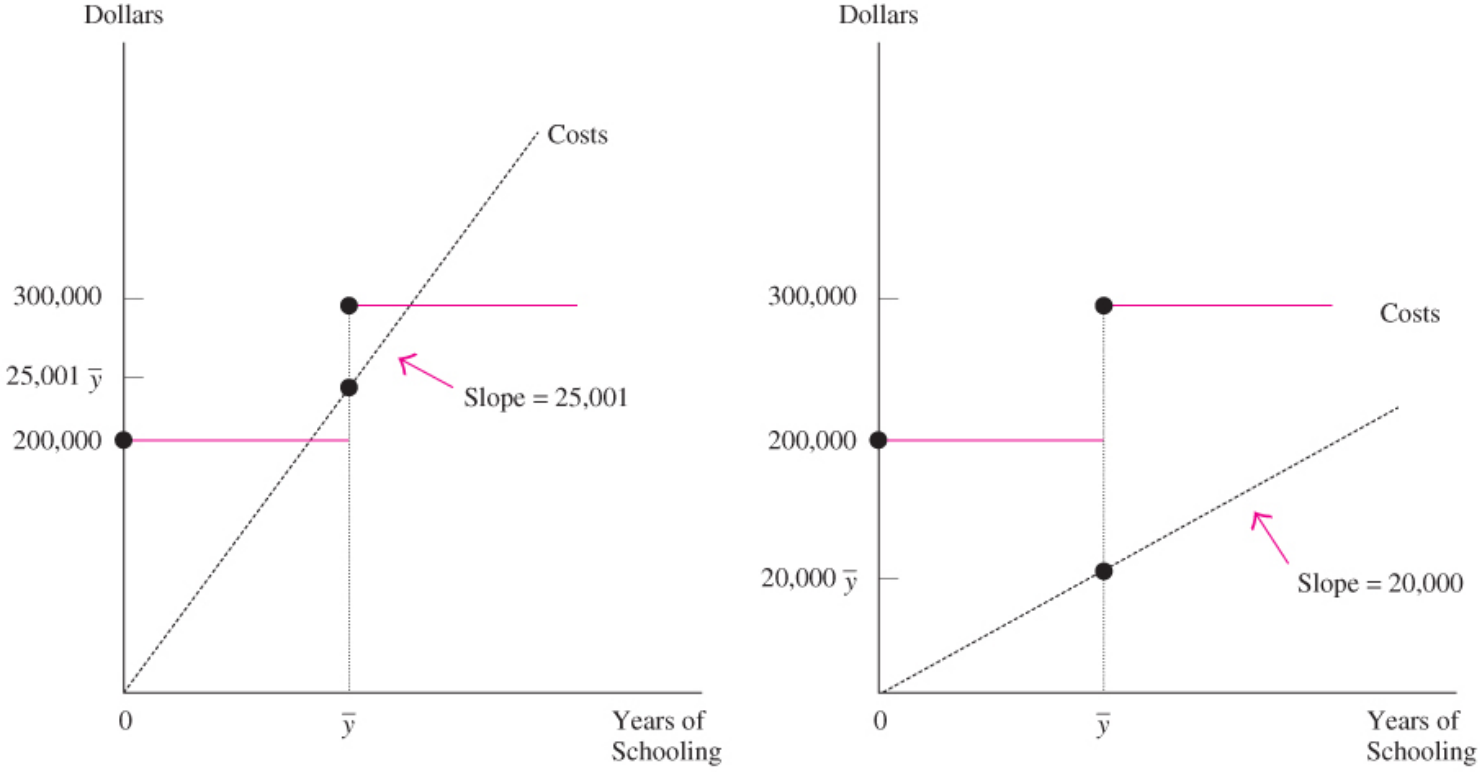
We assume that obtaining credits is more expensive for less-able workers, a year's worth of college credits costs $20,000 for a high-productivity worker, but $25,001 for a low-productivity worker.

Tuition and fees do not differ according to ability but the real cost of a college credit is higher for a low productivity worker.

Education as a Signal

FIGURE 6-7 Education as a Signal

Workers get paid \$200,000 if they get less than $\bar{y}$ years of college, and \$300,000 if they get at least $\bar{y}$ years. Low-productivity workers find it expensive to invest in college, and will not get $\bar{y}$ years. High-productivity workers do obtain $\bar{y}$ years. As a result, the worker's education signals if he is a low-productivity or a high-productivity worker.



(*a*) Low-Productivity Workers

(*b*) High-Productivity Workers

- A separating equilibrium requires that low-productivity workers do not go to college at all. This will occur whenever the net return from getting zero years of college exceeds the net return from getting $\bar{y}$ years
- When a low-productivity worker does not go to college, he takes home $200,000
- If he goes to college $\bar{y}$ years, his net salary is the vertical difference between the 300,000 wage offer and the cost of going to college for $\bar{y}$ years
- Therefore, the low-productivity worker will not attend college if

$$200{,}000 > 300{,}000 - (25001 \times \bar{y})$$

$$\bar{y} > 3.999$$

- A separating equilibrium requires that high-productivity workers do get $\bar{y}$ years of college
- The net salary if he goes to college for $\bar{y}$ years is the vertical difference between the \$300,000 wage offer and the cost of going to college $(20000\times \bar{y})$
- Therefore, the high-productivity worker get $\bar{y}$ years whenever

$$200{,}000 < 300{,}000 - (20000\times \bar{y})$$

$$\bar{y}<5$$

- Both conditions implies that low-productivity workers do not go to college and that high-productivity workers do whenever

$$3{,}999 < \bar{y} < 5$$

The signaling model shows that education can play the role of signaling the worker's innate ability without increasing the worker's productivity.

Human capital model → suggests that human capital investments, such as education, provide a way out of low incomes and poverty

Signaling model → says that education doesn't really increase a worker's innate productivity

Implications of Schooling as a Signal

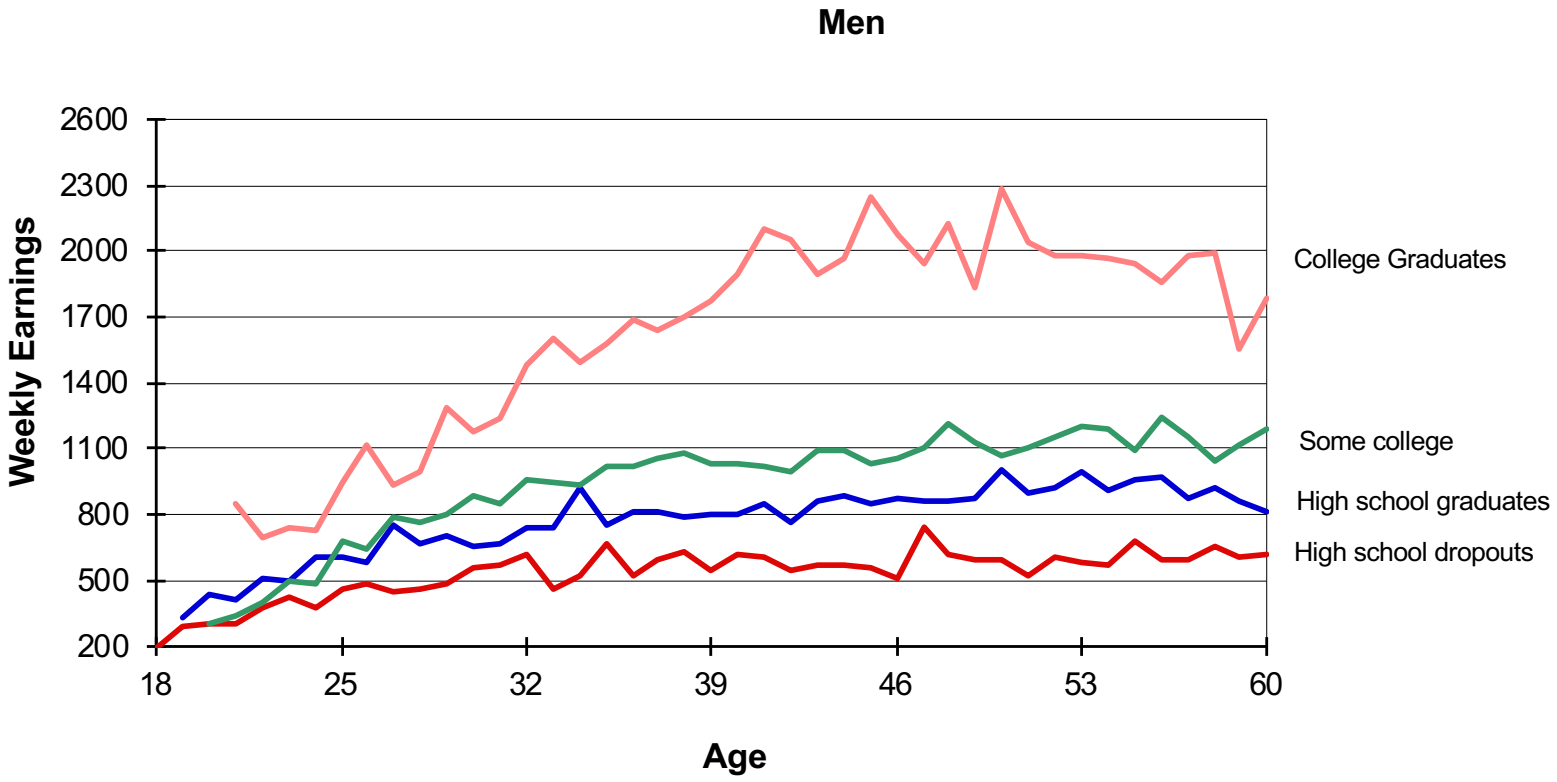
- Education is more than a signal, it alters the stock of human capital.
- Social return to schooling (percentage increase in national income) is likely to be positive even if a particular worker's human capital is not increased.

Post-School Human Capital

Three important properties of age-earnings profiles:

- High Educated workers earn more than less -educated workers
- Earnings rise overtime but at a decreasing rate
- The age-earnings profiles of different education groups diverge over time

Age-Earnings Profiles of Full-Time Workers, 2010



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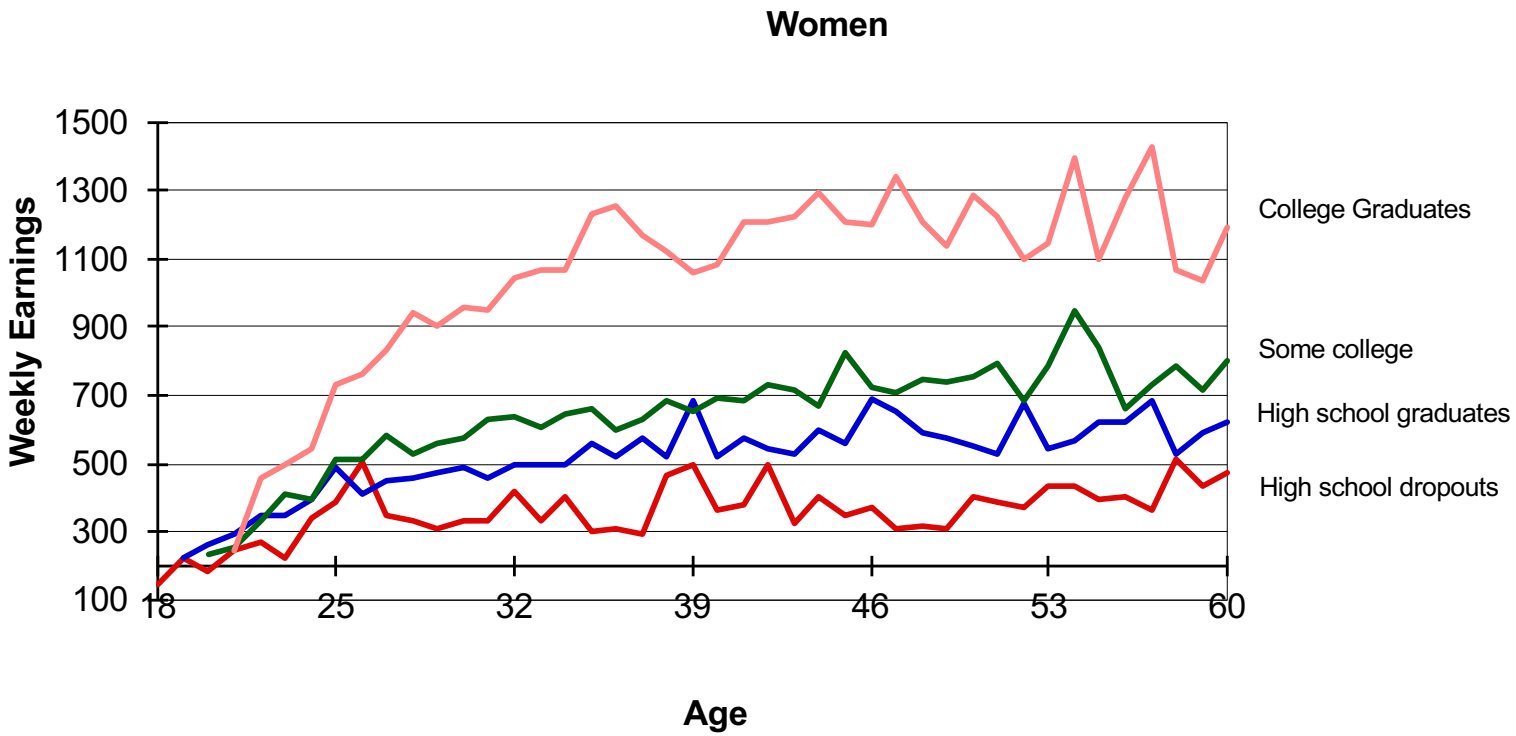

Source

Borjas, G. (2019). Labor Economics. 6th ed. McGraw-Hill, USA.