Lecture 6: Human Capital(updated version)

Labor Economics, Fall 2025

Zhaopeng Qu
Business School, Nanjing University
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Human Capital Investment

Very brief review of the previous lecture

- Labor market outcomes:
  - Wages and employment
- Why do wages and employment vary across workers?
  - Because of the labor supply and labor demand
- The only difference between workers is the amount of hours they are willing to work.
- In reality, workers are not identical in terms of their productivity.
- Why? Because of the **human capital investment**.

Opening Questions

- Why you chose to study economics in Nanjing University?
- What are you going to do after graduation?
  - Find a job in a company or government agency
  - Pursue a advanced degree
  - Start your own business
- What are the most important factors that influence your decision?
- All these decisions are also related to a core concept in labor economics: **human capital investment**.

Human Capital Investment

- Investment: an act of spending money now to gain future benefits.
    1. Incur an initial cost
    2. Expect to recoup in some future period
- Human Capital Investments
    1. Education and training
    2. Health
    3. Migration
    4. Job search
- Special feature: investment embodied in people

Human Capital Investment

- **Theodore Schultz**,Professor of Economics at University of Chicago.
- **1979 Nobel Prize Winner**
- The most contribution to the field of labor economics is his work on human capital.

H.C. in The Wealth of Nations

- Stock of physical capital:
  - natural resources, buildings, machines
- Stock of human capital:
  - accumulated investments in education, training, migration, health and technology
- Even H.C.is more important than P.C. on the economics
  - Germany/Japan after WWII

Three Stages of H.C.Investment

- Early childhood
  - Skill acquisition determined by others
  - Parental resource and guidance
  - Environment
  - Early school experience
- Teenagers and young adults as full-time students
  - Formal schooling
- Adults, after entering the labor market
  - On the job training

The typical questions

- Why some guys obtain a lot of schooling and others drop out at early age?
- How does the rate of return to schooling compare with the rate of return on other investments?
- How workers make their investments decisions and investigates how these choices influence the evolution of earnings over the life cycle?

Position in Labor Economics

- It is one of the most important ideas in labor economics.
- The perspective is important in understanding both investment incentives and the structure of wage and earnings.

Structure

- Schooling decision
  - College vs. high school
  - Continuous schooling choice
- The signaling model
  - Is the investment socially worthwhile?
- Post-school investment(OJT)

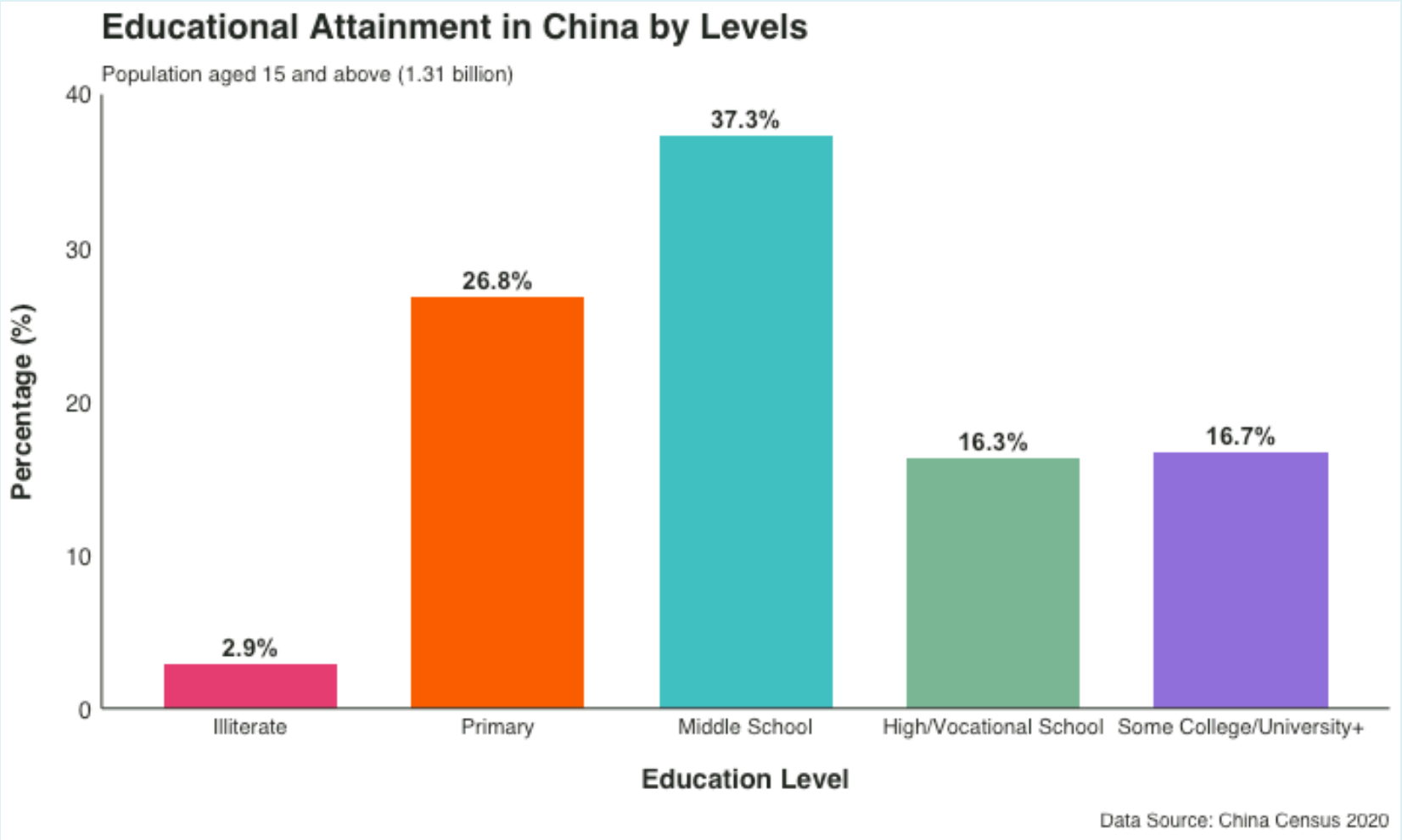
The distribution of education in U.S.

TABLE 6-1 Educational Attainment of U.S. Population, 2007 (Persons Aged 25 and over)

Source: U.S. Bureau of Labor Statistics, *Annual Demographic Supplement of the Current Population Surveys*, March 2007.

	Highest Grade Completed (Percentage of Population in Education Category)					
Group	Less Than High School	High School Graduates	Some College	Associate Degree	Bachelor's Degree	Advanced Degree
All Persons	12.7%	33.2%	16.7%	8.6%	18.9%	9.9%
Gender:						
Male	13.3	33.4	16.1	7.7	18.7	10.8
Female	12.2	33.0	17.3	9.5	19.0	9.0
Race/ethnicity:						
White	8.3	33.4	17.4	9.1	20.8	11.1
Black	15.0	38.6	18.9	8.8	13.1	5.7
Hispanic	36.6	31.4	13.0	6.2	9.4	3.3

The distribution of education in China



Labor Market Characteristics in U.S.

TABLE 6-2 Labor Market Characteristics, by Education Group, 2007 (Persons Aged 25–64)

Sources: U.S. Bureau of Labor Statistics, *Annual Demographic Supplement of the Current Population Surveys*, March 2007.

		Less Than High School	High School Graduates	Some College	College Graduates
All workers:	Labor force participation rate	62.9	76.0	81.3	85.9
	Unemployment rate	8.6	4.9	3.7	1.8
	Annual earnings (in $1,000)	22.8	33.0	39.3	68.2
Gender:					
Men	Labor force participation rate	75.6	83.6	87.4	92.5
	Unemployment rate	8.4	5.6	3.9	1.9
	Annual earnings (in $1,000)	26.2	39.6	47.2	84.8
Women	Labor force participation rate	48.1	68.1	76.1	79.7
	Unemployment rate	8.8	3.9	3.5	1.8
	Annual earnings (in $1,000)	16.8	25.0	31.9	50.6
Race/ethnicity:					
White	Labor force participation rate	57.7	76.6	81.2	86.2
	Unemployment rate	8.8	4.4	3.2	1.7
	Annual earnings (in $1,000)	26.1	35.2	49.9	70.7
Black	Labor force participation rate	53.7	71.8	80.9	88.2
	Unemployment rate	14.9	7.8	5.6	2.4
	Annual earnings (in $1,000)	19.3	28.0	34.3	55.3
Hispanic	Labor force participation rate	69.8	79.1	82.9	85.7
	Unemployment rate	7.3	3.9	4.4	2.1

The Schooling Model

The Schooling Model

- Objective: Maximize the present value of lifetime earnings
- Present value formula

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

- y is the dollar amount received t periods in the future.
- r is the discount/interest rate.
- Benefits of education and training only come from the investment aspect
- "Side effects"of education in increasing utility are ignored in the model
  - Consumption aspect

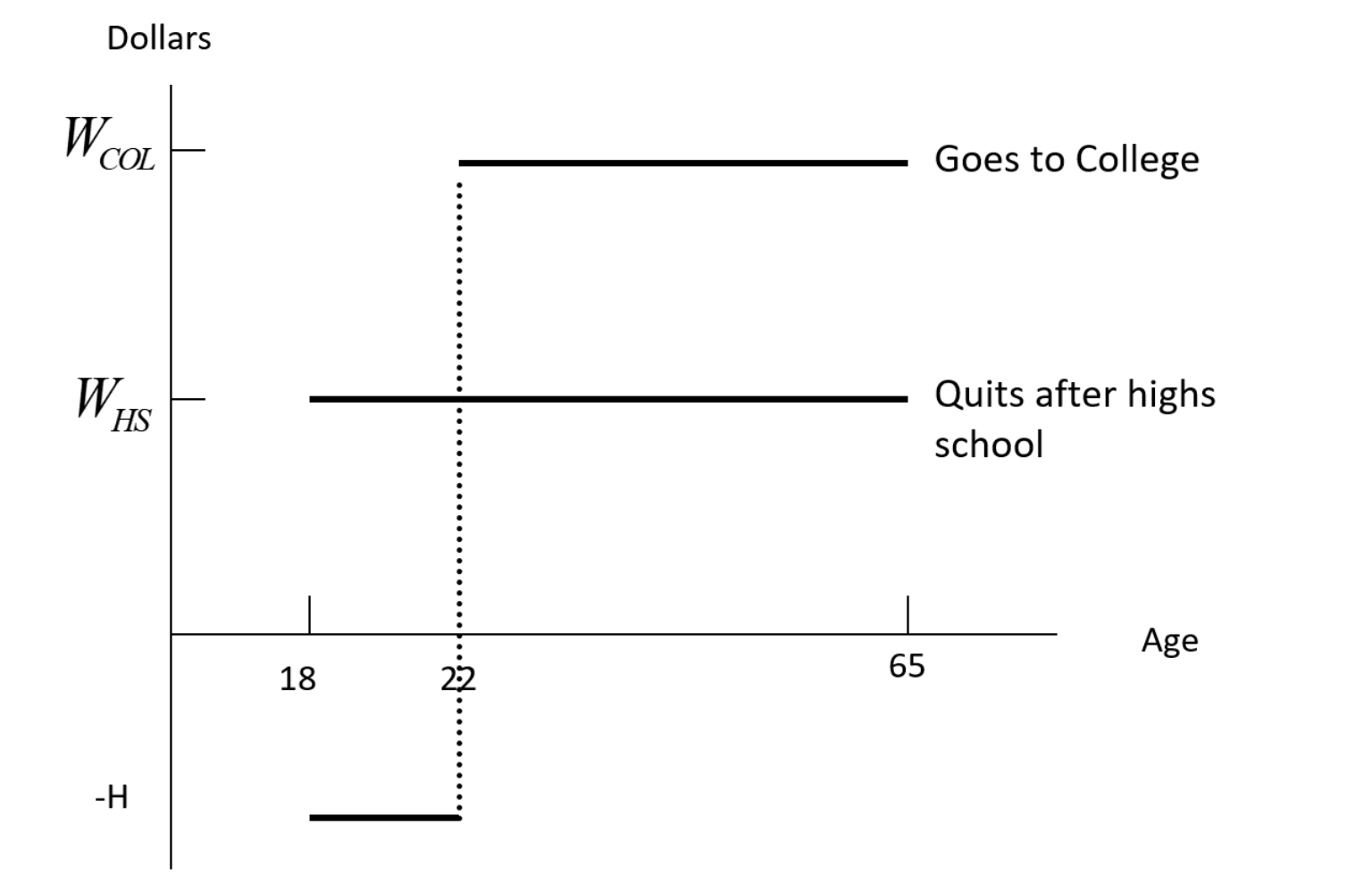
Costs of Education

- Direct expenses:
  - Tuition
  - Expenditure on books and school supplies
- Foregone earnings:
  - Opportunity cost of time
- Psychic costs

Consider the Decision of College

- Consider a high school graduate at 18 years
- He earns W_{HS} if quitting school after high school
- If he goes to college,
  - pays direct cost H
  - delays labor market entry by 4 years
  - earns W_{COL} after college

Potential Earnings Stream



Consider the Decision of College

$$PV_{col} = -H - \frac{H}{(1+r)} - \frac{H}{(1+r)^2} - \frac{H}{(1+r)^3} + \frac{W_{col}}{(1+r)^4} + \frac{W_{COL}}{(1+r)^5} + \ldots + \frac{W_{cot}}{(1+r)^{41}}$$

$$PV_{HS} = W_{HS} + \frac{W_{HS}}{(1+r)} + \frac{W_{HS}}{(1+r)^2} + \ldots + \frac{W_{HS}}{(1+r)^{41}}$$

- A person chooses to go to college only if

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

Benefits and Costs of College

- Benefits of College

$$PVB_{COL} = \frac{W_{COL} - W_{HS}}{(1+r)^4} + \frac{W_{COL} - W_{HS}}{(1+r)^5} + \ldots + \frac{W_{COL} - W_{HS}}{(1+r)^{41}}$$

- Costs of College

$$PVC_{COL} = (H + W_{HS}) + \frac{H + W_{HS}}{(1+r)} + \frac{H + W_{HS}}{(1+r)^2} + \frac{H + W_{HS}}{(1+r)^3}$$

A person chooses to go to college only if:

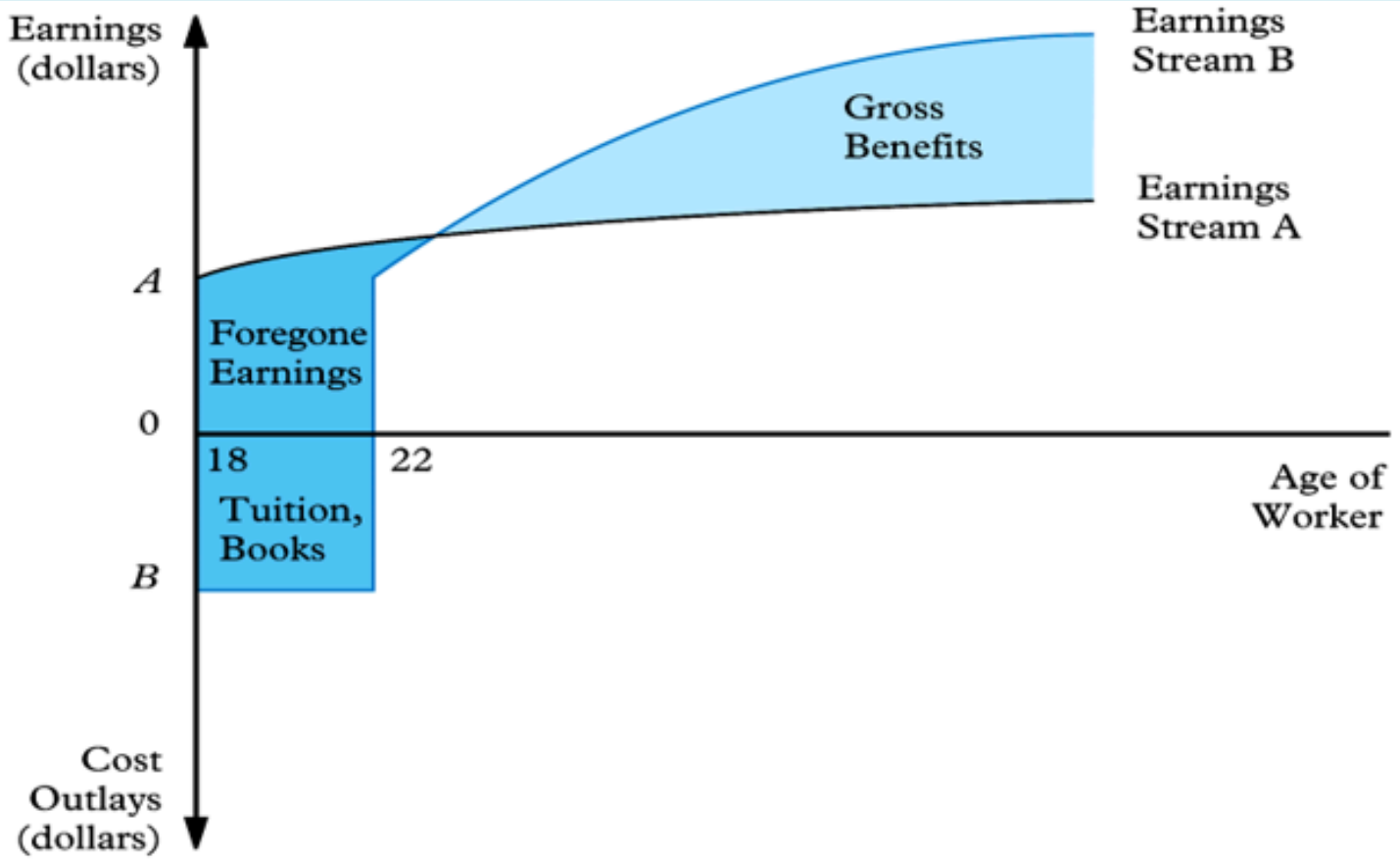
$$PVB_{COL} > PVC_{COL}$$

The College Decision in General

- The income flow may not be flatted, but a increasing profile.
  - The earnings streams are not constant
- When there are more than two schooling options.
- The "stopping rule" tells the individual when it is optimal to quit school and enter the labor market.

The College Decision in General

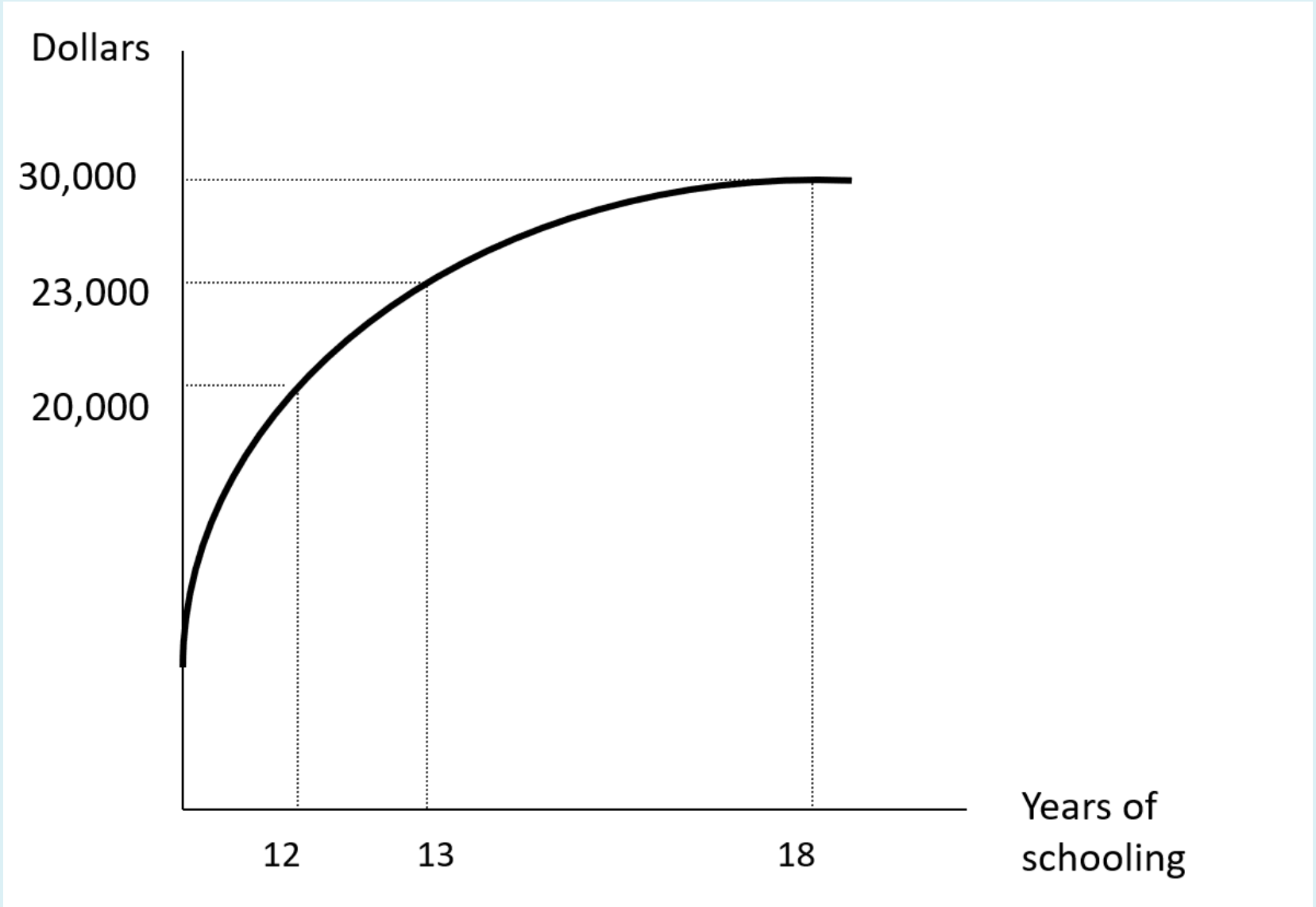
- The earnings streams are not constant



Continuous Schooling

- The Wage-Schooling Locus
- Three Properties:
  - a) Upward sloping
  - b) The slope is dy/ds: additional (annual) earning from an additional year of schooling
  - c) Concave: Diminishing marginal returns to human capital accumulation

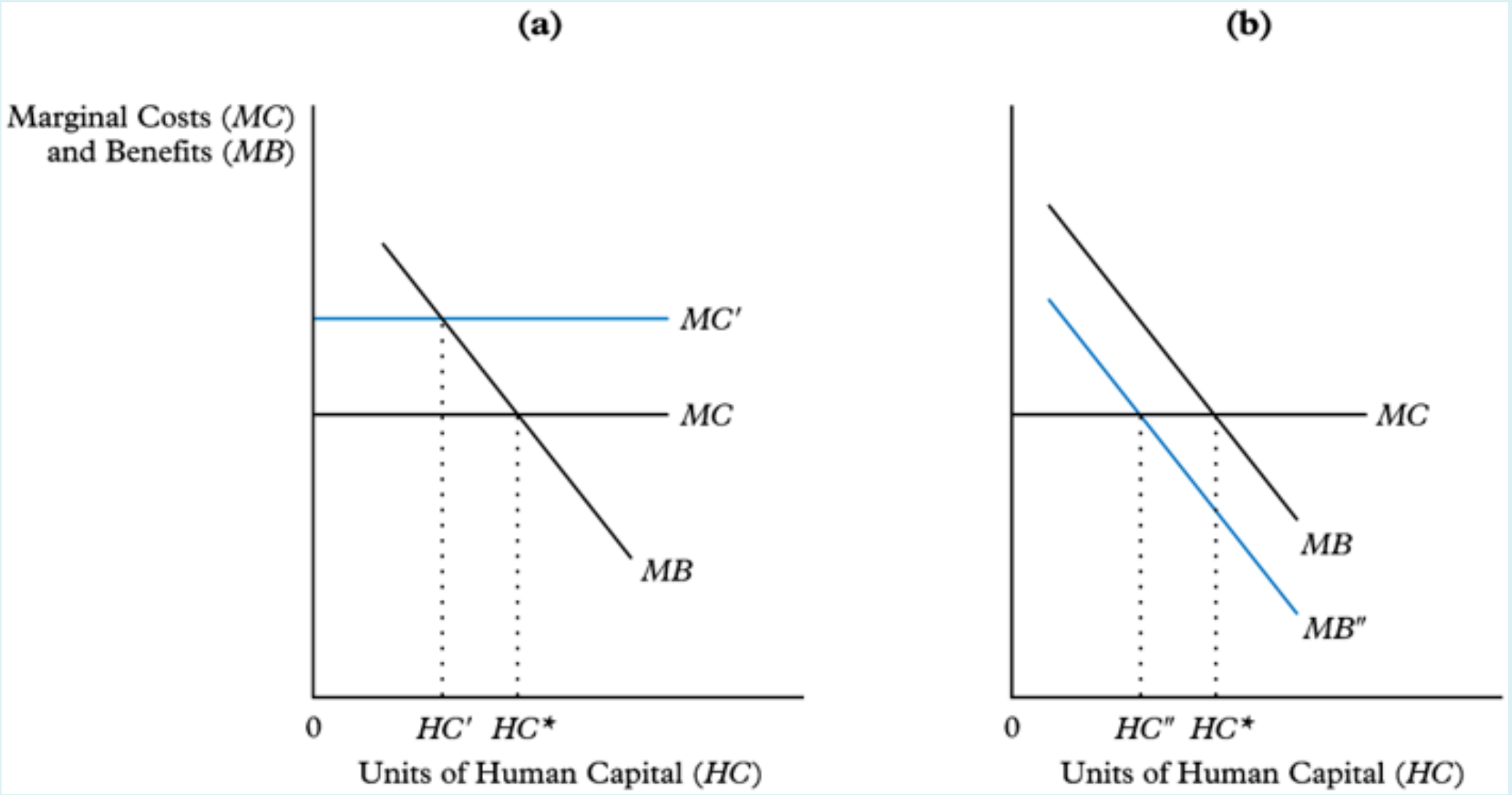
The Wage-Schooling Locus



Optimal Acquisition of Schooling

- Consider an additional year of schooling
  - Marginal Benefit (MB): Present value of a stream of extra annual earnings from the extra schooling
  - Marginal Cost (MC): costs of an extra year of schooling
- Optimal schooling: MB=MC
  - Higher MC reduces schooling
  - Lower MB reduces schooling

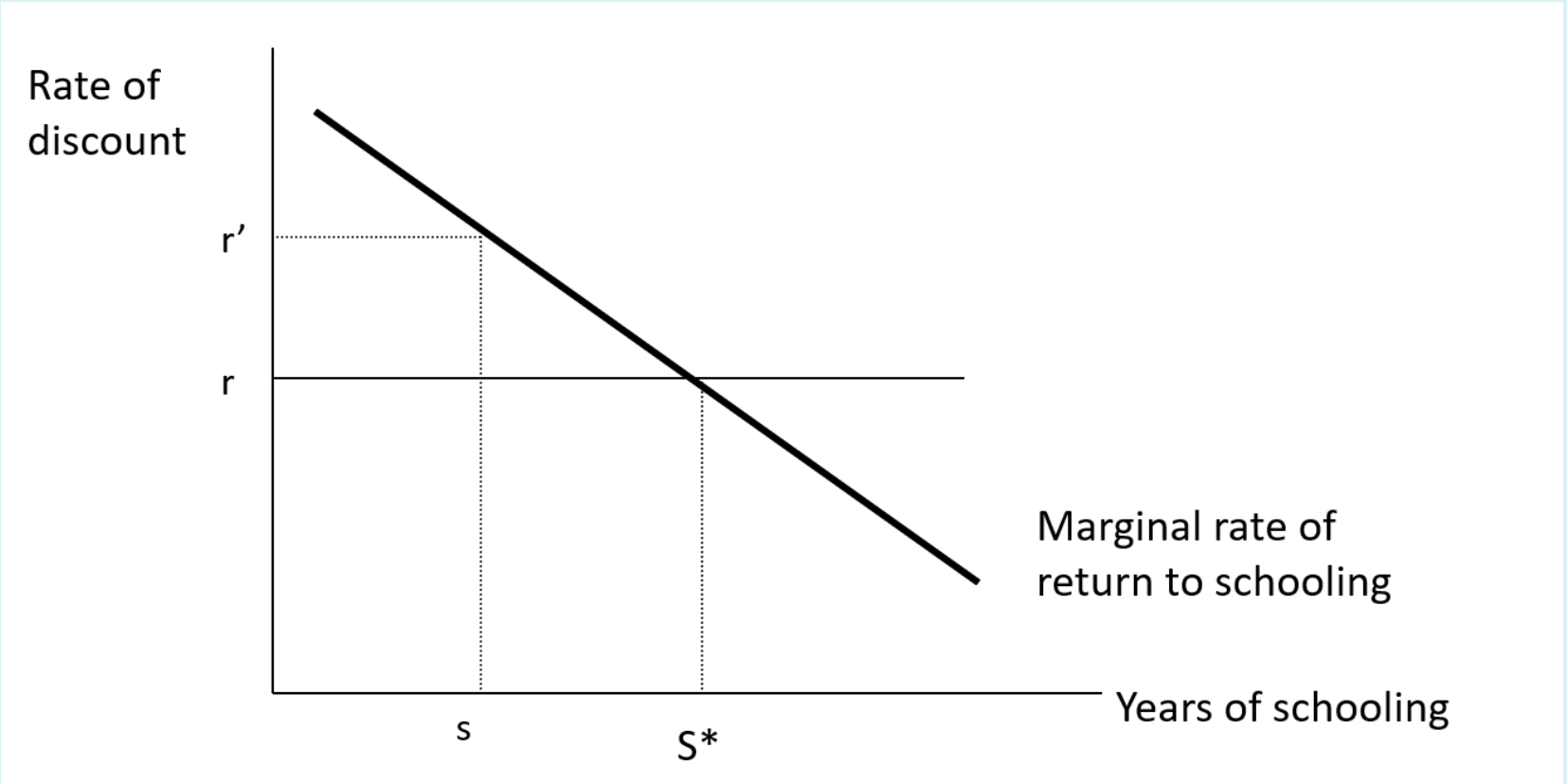
The Optimum Acquisition of Human Capital



The Rate of Return to Schooling

- Since **the rate of return to schooling** is a key factor in determining the optimal schooling level, we need to define it more formally.
- **Rate of Return to Schooling (ROR)**: d(lny)/ds: percentage change in earnings associated with an additional year of schooling and also called marginal rate of return to schooling (MRR)
- On the wage-schooling locus, it must decline as schooling increase
- A central concept in empirical research, often compared with the rate of return to capital to determine over/under investment in human capital

Optimal Schooling and the ROR



If the worker's rate of discount equals r, then it is optimal for the worker to choose S^*.

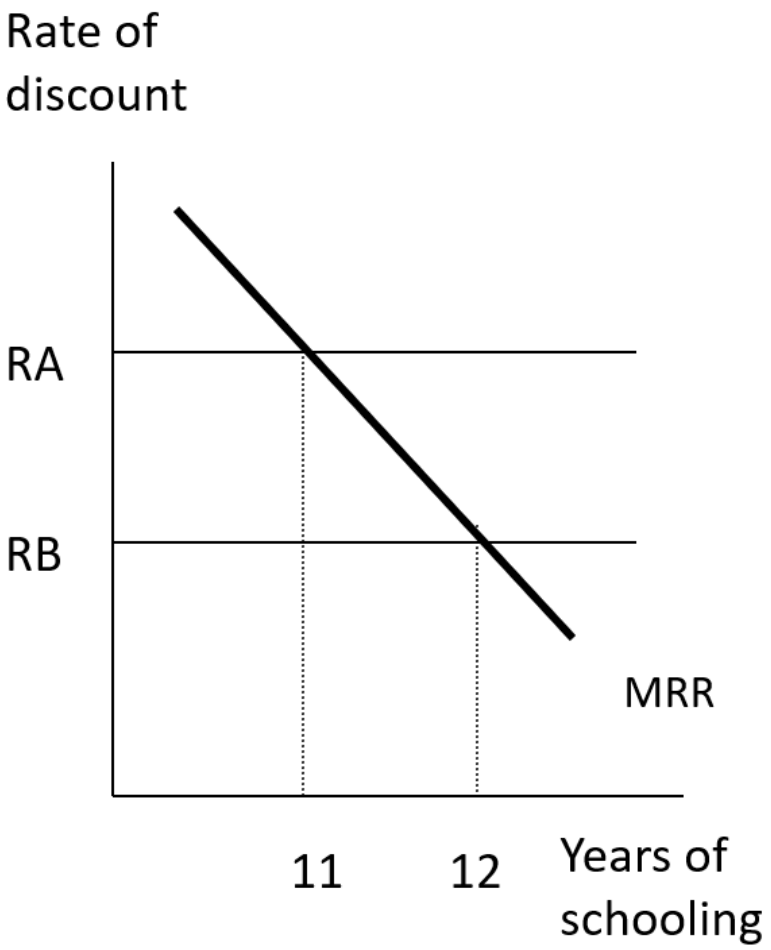
Education and Earnings

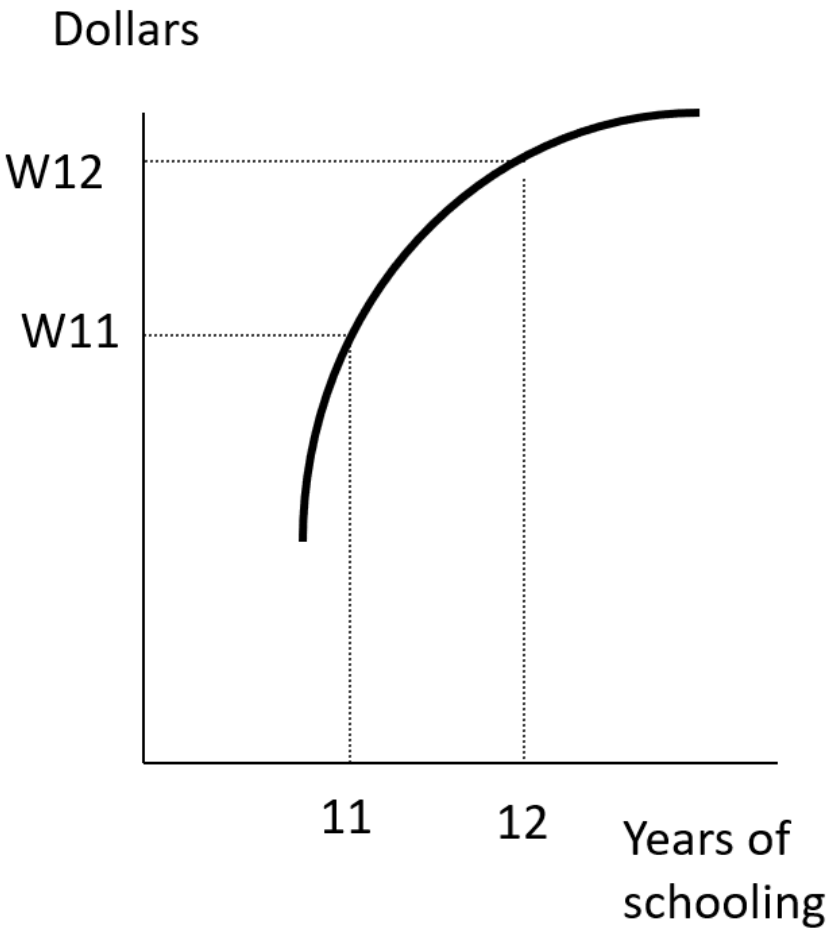
- **Question**: *Why do we observe that different workers have different levels of schooling?*
- Workers have different levels of schooling for two reasons:
  - Different rates of discount
  - Different marginal rates of return
- Different educational levels lead to different labor incomes
- **Question**: *Can we calculate rates to education based on observed differences in wages and schooling?*
- **Answer**: *No, we cannot calculate rates to education based on observed differences in wages and schooling.*

Differences in the Rate of Discount

- A and B's marginal rates of return to schooling are the same
  - Face same wage-schooling locus
- A faces a higher discount rate than B due to
  - more present-orientedness
  - credit constraint (higher borrowing cost)
- Result: A choose 11 years of schooling; B chooses 12 years of schooling
- The wage differential lets us estimate the rate of return to education

Differences in the Rate of Discount

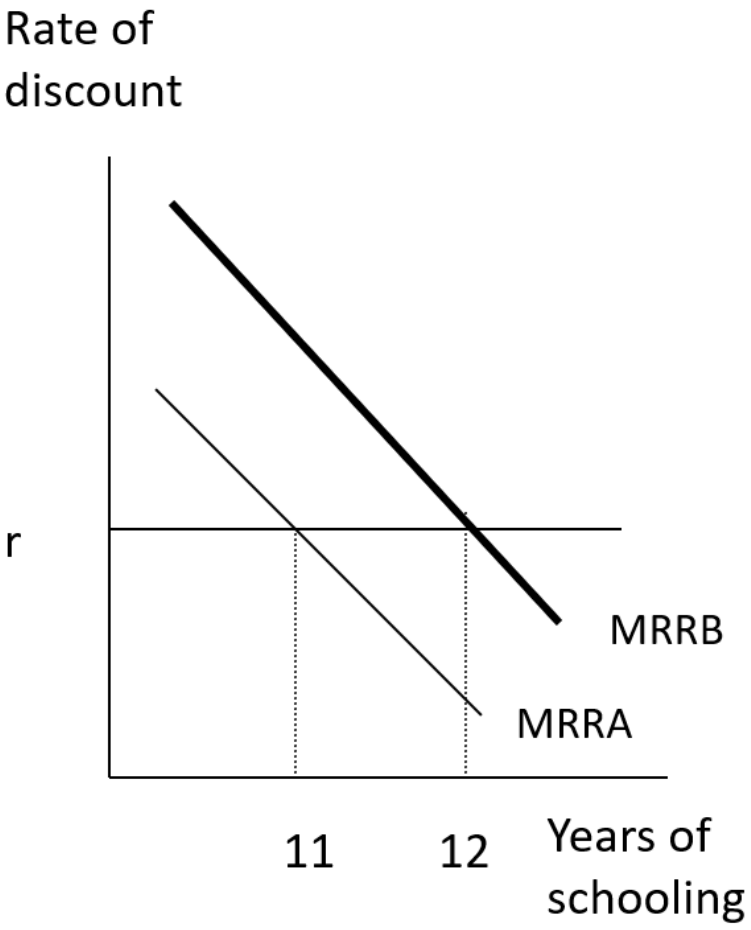


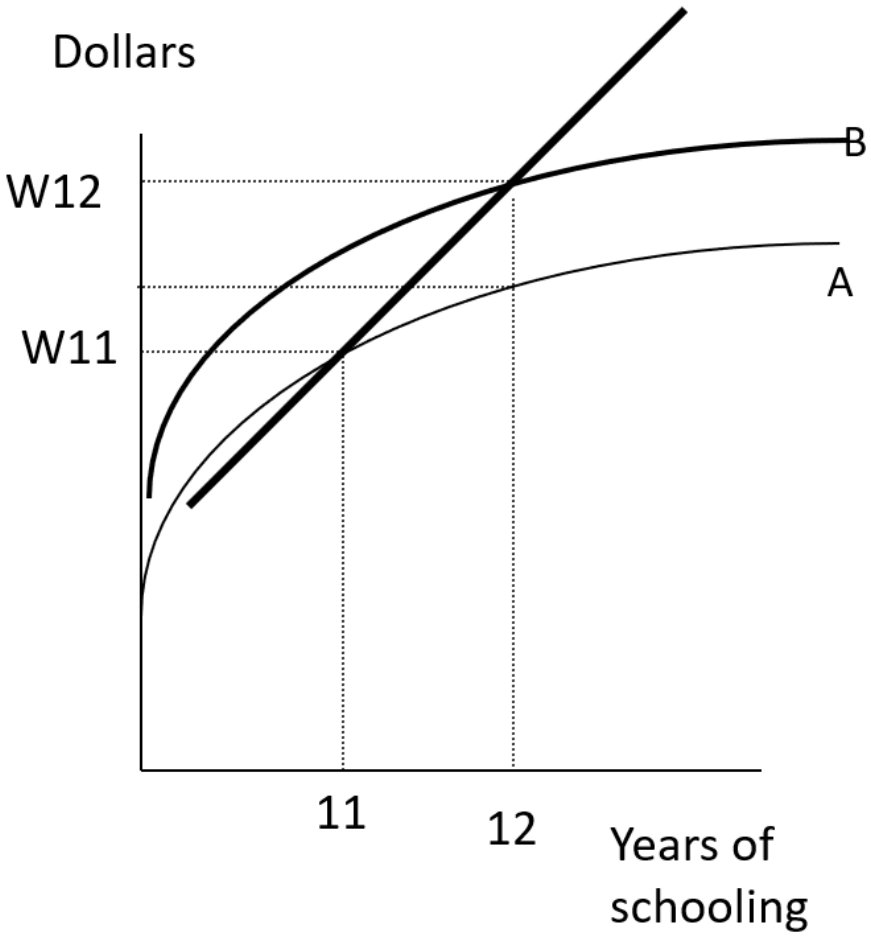


Different Ability

- All workers have the same discount rate
- Face different wage-schooling locus
  - Different marginal rate of return to schooling
  - High ability person (B) has higher marginal return from schooling
- Result: B chooses 12 years, A 11 years
- The wage differential over-estimates the true rate of return to schooling

Different Ability





Why Do We Care About the Bias

- Individuals base their schooling decisions on the estimates
- Accurate estimates are needed to evaluate government intervening policies in education for the purpose of addressing poverty and wage inequality
  - Subsidize schooling
  - Mandatory education

Estimate the Returns to Schooling

Mincer Wage Equation

- Jacob Mincer (1974)

$$\log(y) = a + bS + cE + dE^2 + u$$

where y is earnings, S is schooling years, E is working experiences, and u is the error term.

- Here b represents the returns to education
  - Percentage increase in income from one additional year of schooling
- A simple regression model can explain 20-35% of observed earnings variation
- Estimated worldwide with estimates ranging from 0.05 to 0.15 (5-15% per year)
- Linear model fits the data well even in countries with very different economies

Mincer Wage Equation

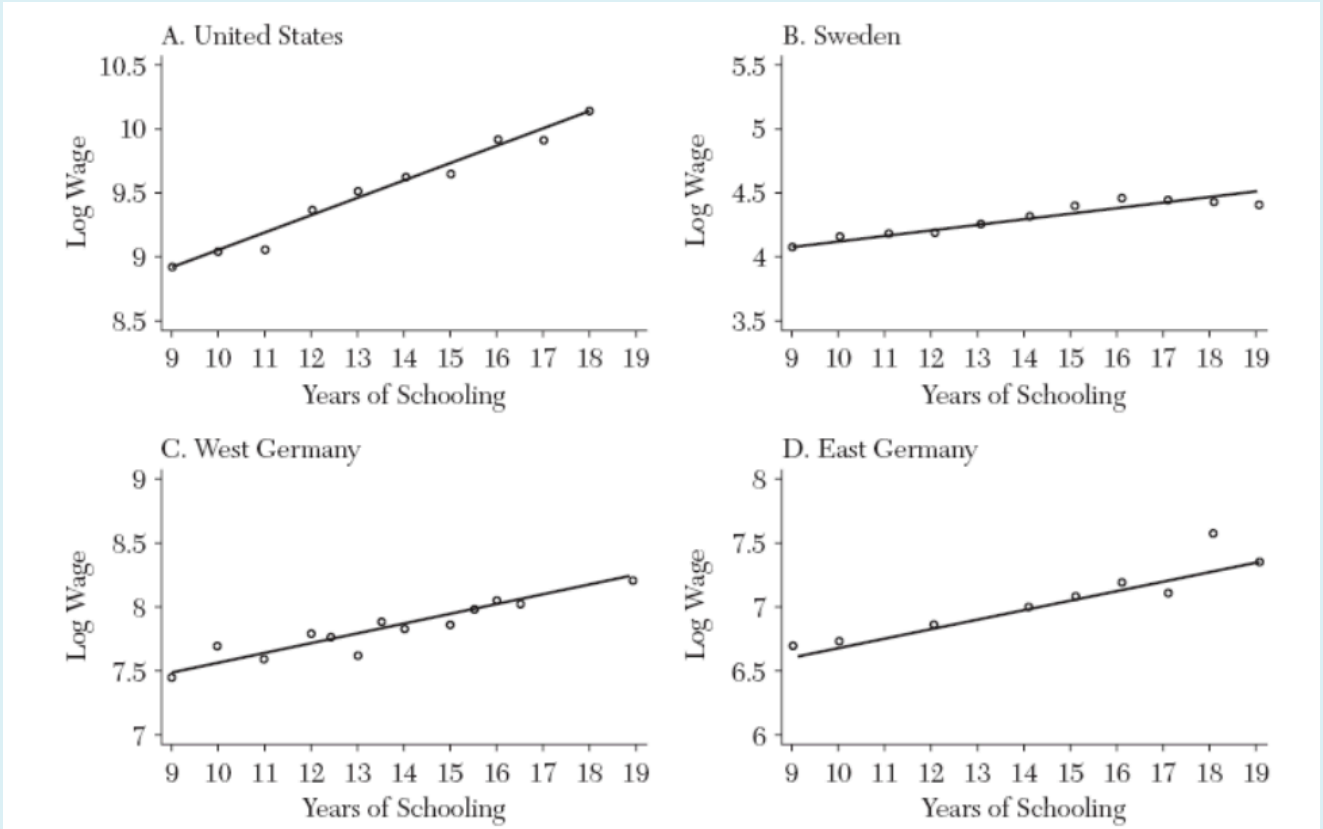


Figure 1. Unrestricted Schooling-Log Wage Relationship and Mincer Earnings Specification

Source: Angrist and Lindhal (2001) JEL

Issues with Mincer Regression

How to interpret the coefficient on schooling?

1. **Ability bias** - High-ability people get more education AND earn more
2. **Measurement error** - Self-reported schooling may be inaccurate
3. **Signaling vs. Human Capital** - Does education increase productivity or just signal it?

Econometric Review: Ability Bias

- **The true model is:** Estimate the return to schooling as:

$$\log(y_i) = \alpha + \beta S_i + \gamma A_i + u_i$$

where y_i = log wage, S_i = schooling, A_i = ability, u_i = error term

- However, if we cannot observe ability, we can only regress: **The estimated model is:**

$$\log(y_i) = \alpha + \beta S_i + e_i$$

where $e_i = \gamma A_i + u_i$

Ability Bias

Then:

$$p\lim\left(\hat{\beta}_{OLS}\right) = \frac{\text{Cov}(y_i, s)}{\text{var}(s)} = \frac{\text{Cov}(\alpha + \beta s + e, s)}{\text{var}(s)}$$

At last:

$$p\lim\left(\hat{\beta}_{OLS}\right) = \beta + \gamma\frac{\text{Cov}(A, S)}{\text{var}(s)}$$

- The direction of the bias is:

	Corr(A, S) > 0	**Corr(A, S) < 0**
γ > 0	Positive bias	Negative bias
γ < 0	Negative bias	Positive bias

Solutions to Ability Bias

There are several possible solutions:

1. Better controls for "ability" (IQ, AFQT, test scores)
2. **Twin studies** (compare identical twins with different schooling)
3. **Instrumental variables** (find something that affects schooling but not ability)
4. **Other non-experimental methods** like DID (Difference in Differences), RD (Regression Discontinuity), and synthetic control etc.

Simple Solution: Control for Ability

- The simplest way: find a measure of ability (IQ, AFQT, or similar)
- BUT:
  - **No good reason to expect the relative ability bias to be constant across people**
  - **This is especially a problem if returns differ across ages and other groups**
  - **The relationship between ability and schooling varies greatly across time and individuals**

Good Controls vs. Bad Controls

Thumb rule: Timing matters!

Good Controls (measured before treatment):

- Parental education
- Family income
- Test scores before college
- Predetermined characteristics

Cannot be changed by treatment

Bad Controls (measured after treatment):

- Occupation
- Current income
- Job characteristics

May be affected by treatment → creates selection bias

- Example: Controlling for occupation biases estimates downward because education determines occupation

Controlling for Ability

Table 3: Effects of ability controls on estimates of the returns to education -- early studies

	Study							
	AM-68 (1)	HWC-70 (2)	G-77 (3)	G-77 (4)	GM-72 (5)	GM-72 (6)	C-78 (7)	C-78 (8)
A. OLS estimates*								
No ability controls	.0205 (.0285)	.0346 (.0070)	.022 (.005)	.065 (.005)	.0508 (.0039)	.0408 (.0041)	.041 (.006)	.036 (.007)
Ability controls	.0213	.0171 (.0074)	.014 (.005)	.059 (.005)	.0433 (.0044)	.0365 (.0046)	.030 (.007)	.027 (.008)
Ability variable	Math SAT	AFQT	IQ	IQ	AFQT	AFQT	IQ	IQ
Other controls	Field, degree, occupation, experience	Age/Race	Age	Experience	Age, length of military service	Age, length of military service, region/urban controls father's occ.+ schooling	Age, race, region/urban controls	Age, race, region/urban controls plus family background variables
Dependant variable	Annual earnings in 1966	Annual income in 1962 (minus transfers)	Hourly wage in 1969	Hourly wage in 1969	Usual weekly earnings in 1964	Usual weekly earnings in 1964	Hourly wage in 1973	Hourly wage in 1973
Data set	Male Ph.D.'s beginning in 1958-60	Rejected low-AFQT military applicants	NLSYM	NLSYM	1964 CPS veterans	1964 CPS veterans	NLSYM	NLSYM
N	694	2,403	1,362	1,362	1,454	1,454	897	897
B. Adjusting for endogenous ability and measurement error in schooling**				.085 (.009)				.132 (.049)

*Panel A: Except for column 1, these are OLS schooling coefficients in semi-log wage equations. Studies are Ashenfelter and Mooney (1968), Hansen Weisbrod, and Scanlon (1970), Griliches (1977), Griliches and Mason (1972), and Chamberlain (1978). Coefficients and standard errors in column (1) were constructed from coefficients on single year-of-education dummies, averaged and divided by average earnings. Studies were selected for the table because they report comparable specifications with and without ability controls.

**Panel B: estimates include the same controls as in Panel A. The Griliches estimates use instrumental variables and treat schooling and IQ as endogenous. The Chamberlain estimates are from a structural model that allows for measurement error and unobserved ability. The Chamberlain dependent variable in the structural model is the hourly wage in 1971.

Controlling for Ability

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Angrist and Kruege(1999)

Within Family: Siblings and Twins

Within Family Estimates

- Some unobserved differences are not innate abilities, but are based on *family characteristics* such as parental income and education, parental occupation, and family structure, etc.
- These family characteristics are also crucial factors for the market income and many others outcomes for the individual.
- Within families, these differences should be fixed - the same for all siblings or twins
- By comparing siblings or twins, we can difference out the family effect.

Estimating Family Averages

- The regression equation with family background:

$$\text{Ln}\, y_{ij} = a + bS_{ij} + cE_{ij} + dE_{ij}^2 + fF_j + e_{ij}$$

- where F_j represents jth family background

Within-family differences in demeaned variables:

$$E\left[Y_{ij} - Y_j \mid S, E, F\right] = a + b\left(S_{ij} - S_j\right) + c\left(E_{ij} - E_j\right) + d\left(E_{ij}^2 - E_j^2\right) + f$$

Equivalent to:

$$\log(y_{ij}) = \hat{a} + \hat{b}S_{ij} + \hat{c}E_{ij} + \hat{d}\,E_{ij}^2 + \hat{f}_{\,j} + \hat{e}_{ij}$$

where $\hat{f}_{\,j}$ is a family fixed effect

Twins Studies

- For **identical twins**: they are twins that are genetically identical to each other. They are can be seen as *two persons with the same genetic background or innate ability*.
- For the first twin:

$$\operatorname{Ln} y_{1j} = a + bS_{1j} + cE_{1j} + dE_{1j}^2 + f(F_j + A_{1j}) + e_{1j}$$

- For the second twin:

$$\operatorname{Ln} y_{2j} = a + bS_{2j} + cE_{2j} + dE_{2j}^2 + f(F_j + A_{2j}) + e_{2j}$$

where F_j = family background, A_{1j} and A_{2j} = innate ability

Difference of Twins

- Difference the two equations:

$$\text{Ln}\, y_{1j} - \text{Ln}\, y_{2j} = b(S_{1j} - S_{2j}) + c(E_{1j} - E_{2j}) + d(E_{1j}^2 - E_{2j}^2) + f(F_j - F$$

- Since F_j and A_{1j} and A_{2j} are the same for both twins, they cancel out:

$$\text{Ln}\, y_{1j} - \text{Ln}\, y_{2j} = b(S_{1j} - S_{2j}) + c(E_{1j} - E_{2j}) + d(E_{1j}^2 - E_{2j}^2) + e_{1j} - e_{2j}$$

- This is the **fixed effects estimate within family**.

- Since **Identical twins share both family background AND genetic ability**, the same estimate equation eliminates both family background and ability bias.

Ashenfelter and Rouse (1998)

- Collected data at the **Twins Festival** in Twinsburg, Ohio, USA.
- Surveyed twins:
  - Are you identical? (both must say yes)
  - Earnings, education, and other characteristics
- Useful because get two measures of shared characteristics, can control for measurement error too.

- the largest festival of twins in the world

Measurement Error in Twins Studies

- Educational attainments are self-reported - may suffer from mistakes
- Under classical measurement error, this creates attenuation bias (downward bias)
- Especially problematic after differencing - only 25% of twins differ in schooling

Review: Measurement Error in OLS

- Measurement error in the independent variable X is more problematic than in the dependent variable Y.
- The classical measurement error assumption is that the measurement error(w_i) is uncorrelated with the true value(X_i), thus

$$\text{Cov}(w_i, X_i) = 0$$

- Thus, the OLS estimate is biased towards zero:

$$\text{plim}\left(\hat{\beta}_1\right) = \beta_1 \frac{\sigma^2_{X_{1i}}}{\sigma^2_{X_{1i}} + \sigma^2_w} \leq \beta_1$$

- This is the **attenuation bias** in OLS.

Review: Measurement Error in FE

- In the panel data setting, the measurement error in the independent variable X_{it} will lead worse attenuation bias than in the OLS case.
- Following several normal assumptions, we have the following result:

$$plim(\hat{\beta}) = \beta \frac{\sigma_X^2(1-\rho)}{\sigma_X^2(1-\rho)+\sigma_w^2} < \frac{\sigma_X^2}{\sigma_X^2+\sigma_w^2}$$

- It means that **attenuation bias in fixed-effect model** will be **larger** than the bias in OLS. In other words, measurement error will be magnified in a FE model.
- In the twins studies, if the measurement error in schooling does exist, it will lead to worse attenuation bias than in the OLS case.

IV for Measurement Error

- Use one twin's report of the other's schooling as an instrument
- As long as mistakes in reporting are uncorrelated with the true schooling, this works
- Two-stage least squares:

  1. Predict schooling using one twin's report of the other's schooling
  2. Regress earnings on predicted schooling

Twins Estimates:Ashenfelter and Rouse (1998)

	Without other covariates				
	GLS (1)	GLS (2)	3SLS (3)	First-difference (4)	First-difference by IV (5)
Own education	0.102	0.066	0.091	0.070	0.088
	(0.010)	(0.018)	(0.024)	(0.019)	(0.025)
Avg. education $[(S_1 + S_2)/2]$		0.051	0.033		
		(0.022)	(0.028)		
Age	0.104	0.103	0.103		
	(0.013)	(0.013)	(0.013)		
Age^2 ($\div 100$)	−0.107	−0.104	−0.104		
	(0.015)	(0.015)	(0.015)		
Female	−0.315	−0.309	−0.306		
	(0.049)	(0.049)	(0.049)		
White	−0.106	−0.105	−0.101		
	(0.090)	(0.091)	(0.091)		
Covered by a union					
Married					
Tenure (years)					
Sample size	680	680	680	340	340
R^2	0.262	0.264	0.267	0.039	

- The within-twin estimates are significantly **lower** than the OLS estimate.
- The within-twin estimates with IV correction makes the estimate **closer** to the OLS estimate.
- The true return to schooling is around 9% per year.

Limitations of Twins Studies

- Where's the Variation? Recall our estimating equation:

$$\log(y_{ij}) = \hat{a} + \hat{b}S_{ij} + \hat{c}E_{ij} + \hat{d}E_{ij}^2 + \hat{f}_j + \hat{e}_{ij}$$

- If S_{ij} is the same for both twins, **no contribution** to estimate of b
- Only estimated from twins who are **different** from each other in schooling
- **All identification comes from a small fraction of twins who don't have the same schooling**

Instrumental Variables

- Since the education level is endogenous variable in the Mincer equation, we need to find an instrument that varies schooling but is uncorrelated with unobserved factors (e.g. ability).

Two key assumptions about IV (Z_i):

1. Relevance: Z should be correlated with schooling S

$$\text{Cov}(S_i, Z_i) \neq 0$$

1. Exogeneity: Z must be uncorrelated with other determinants of earnings

$$\text{Cov}(e_i, Z_i) = 0$$

Compulsory Schooling IV

Angrist and Krueger (1991): Use quarter of birth as an instrument

- Quarter of birth affects education through compulsory schooling laws
- This source of variation is exogenous and uncorrelated with ability

How it works:

- Students must stay in school until age 16 (or 17/18 in some states)
- Those born in Q1 enter school older, can leave earlier
- Those born in Q4 enter school younger, must stay longer

Summary of Angrist and Krueger(1991)

- Quarter of birth is a valid instrument: affects education through compulsory schooling laws, not through ability
- Returns to an additional year of schooling are approximately 7.5%, similar to OLS estimates
- **Note**: *If you are more interested in the details, you can recall the content of IV of the Econometrics course in the last semester.*

Key Takeaways

1. Mincer equation provides a simple framework for estimating returns to schooling

2. Ability bias and measurement error are major concerns in the Mincer equation. However, their effects are often offsetting in some extent.

3. Three main solutions:

   - Control for ability (limited)
   - Twins studies (powerful but limited generalizability)
   - Instrumental variables or other non-experimental methods (requires good design and identification)

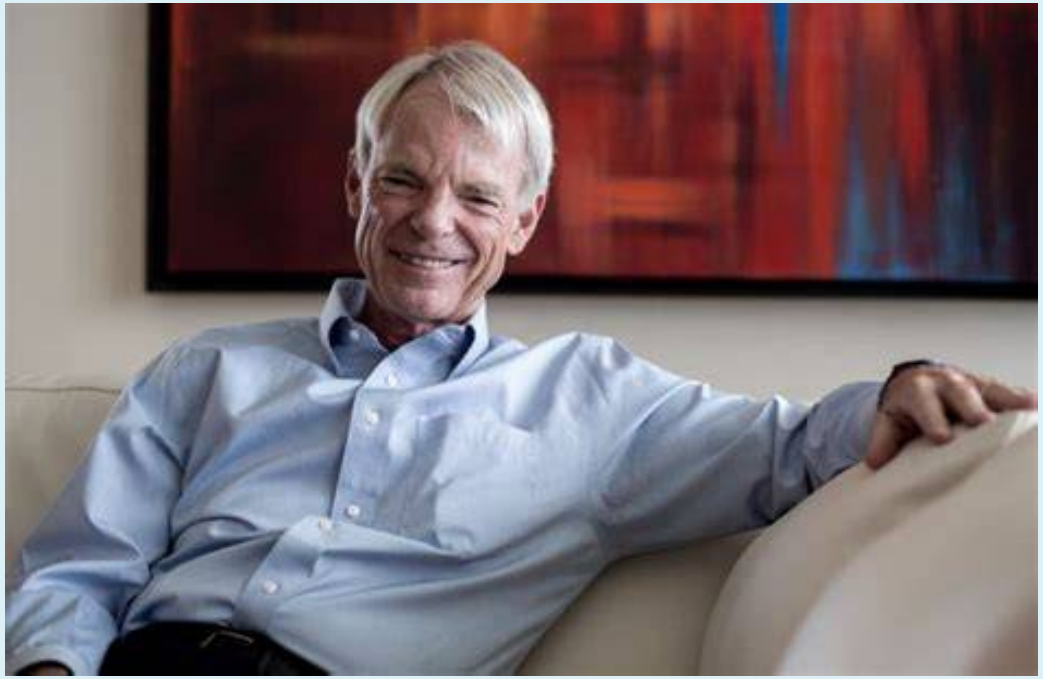
4. Empirical evidence suggests returns around 7-10% per year, with ability bias smaller than expected

Some critical views to Human Capital Theory

- Investment or consumption
- Non monetary benefits
- Education is a signal of ability

Schooling As a Signal

Schooling As a Signal



- The signal model was developed by **Michael Spence**, who won the Nobel Prize in 2001 for this work and related contributions to information

- Education does not increase productivity at all.
- Employers have imperfect information about the productivity of potential employees thus they don't know if they are hiring a highly productivity worker or not.
- Education simply serves as a signal of the individuals' innate ability.

Schooling As a Signal

- Basic Setting:
- 2 groups of applicants:
  - a) high productivity or wage: 2
  - b) low productivity or wage: 1
  - c) Equal proportions
- The employer can't tell them apart
- 2 types of jobs:
  - a) Requires high skill
  - b) Does not require high skill

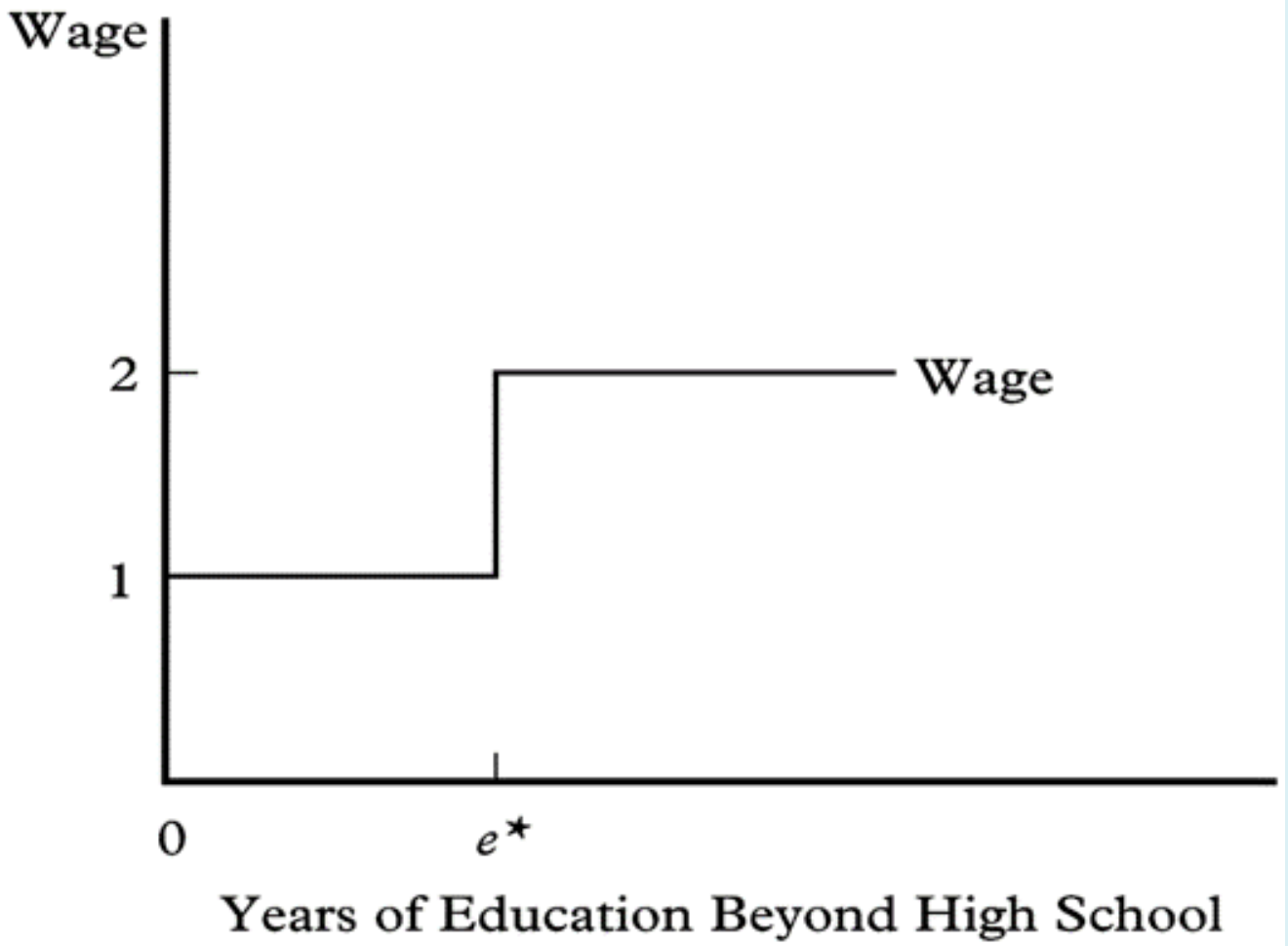
Pooled Equilibrium

- Assign workers randomly between two jobs
- Average salary: $1/2 \times 2 + 1/2 \times 1 = 1.5$
  - Under-paying high productivity workers
  - Over-paying low productivity workers
- Undesirable for high productivity workers and firms
  - Firms are mismatching workers and jobs
  - High productivity workers work at low-skill jobs and vice versa
  - High productivity workers have an incentive to distinguish themselves from low productivity workers

Signaling Equilibrium

- Use schooling: Years of schooling beyond high school
  - Applicants with at least e* years have high productivity
  - Applicants with less than e* have low productivity
- Equilibrium:
  - high productivity workers work at skilled jobs and receive 2
  - low productivity workers work at skilled jobs and receive 1

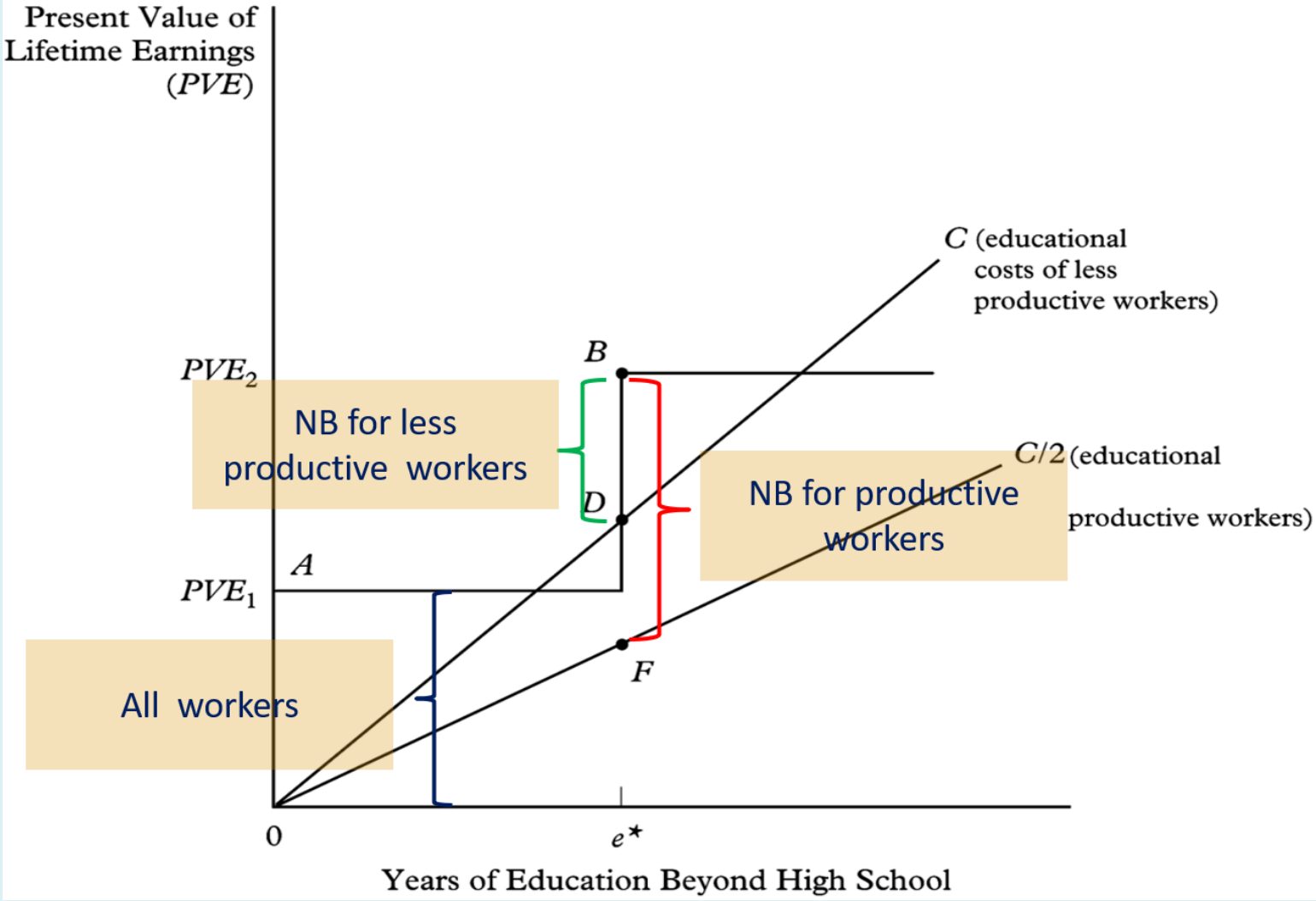
The Benefits to Workers



How Does the Signal Work?

- Costs of schooling
  - Low productivity workers have high costs of acquiring schooling: C
  - High productivity workers have low costs of acquiring schooling: C/2
- Net benefits of acquiring schooling e*:
  - Benefit: receive wage 2
  - Costs: pay C (low) or C/2 (high)
  - Net benefit: BD (low) or BF (high)
- Net benefits of not acquiring schooling e*:
  - receiving wage=1 (AO)

How Does the Signal Work?



Optimal Decision for Signal Acquisition

- Low productivity applicants: Because of $BD < AO$, so do NOT acquire schooling e*
- High productivity applicants: For $BF > AO$, Do acquire schooling e*
- A Separating Equilibrium make employers can tell worker ability from the "signal"

Empirical Evidence: Sheepskin Effect

- The empirical relationship between earnings and years of education isn't smooth.
- There are significant **jumps** in average earnings where you'd expect them—12 years, 16 years, *etc.*.
- *Holding years of education constant*, workers with a degree earn more than those without a degree, on average.
- That is, the simple act of having obtained that piece of paper—your degree—seems to matter a lot. That is the **sheepskin effect** because it is a signal of ability.

Question: Does this provide evidence for signaling?

Signaling or Human Capital?

- Both signaling model and human capital model predict that more education leads to higher earnings
- Implications of the two theories are different
  - a) H.C. theory: government, by subsidizing education, provides a way out of poverty
  - b) Signaling: the expenditures do not increase productivity. Socially wasteful
- In the signaling model, education is still useful:
  - a) sorting workers into the right jobs
  - b) Education could have positive social rate of return even if it does not increase a particular worker's productivity

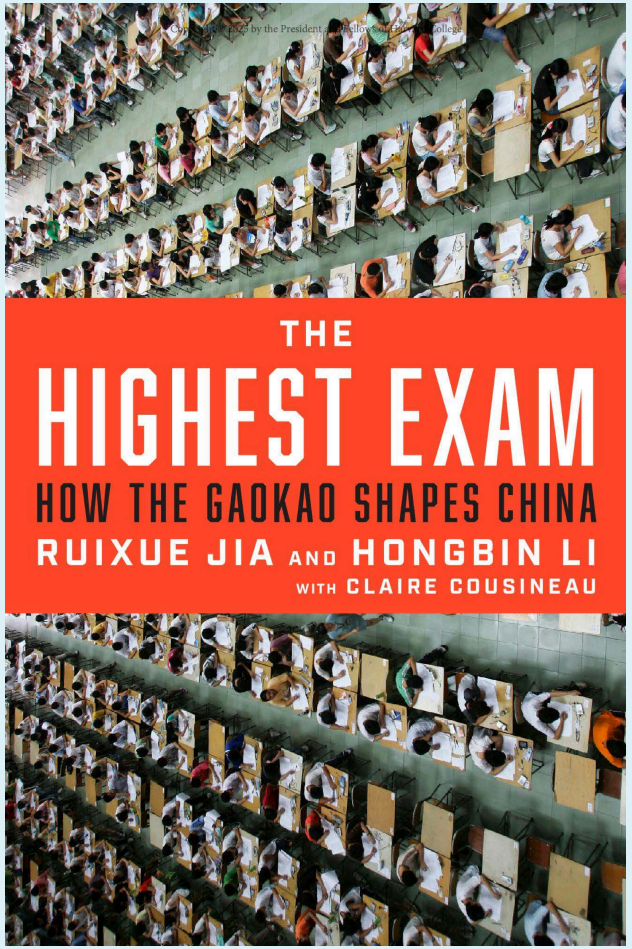
Some Implications to Chinese economy

- Human capital idea is powerful and especially useful in China's context.
  - Over the past 40 years, especially in the last 20 years, Chinese government has invested heavily in infrastructures, transportations, and communications, which has greatly improved the productivity of the economy.
  - However, the investment in human capital has relatively lagged behind the investment in infrastructures.
  - The returns to physical capital has been declining, while the returns to human capital has been stable or even increasing.

Some Implications to Chinese economy

- Signal model is more relevant to recent China's labor market.
  - Post-pandemic Economic Slowdown: Since the pandemic, with the exception of a few sectors like electric vehicles and defense, the overall macroeconomic situation has been sluggish. Consequently, the labor market has also remained depressed.
  - Involution ("Neijuan"): The phenomenon of "involution" is becoming increasingly severe. A major reason is the poor economic conditions, leading to intense competition for limited resources such as educational opportunities and jobs.
  - Signaling Dominance: In this context, the Signaling Model might provide a better explanation for the current state of China's labor market than the Human Capital Model. Education is increasingly used as a screening device rather than just a productivity enhancer.

Further Reading



- Written by Ruixue Jia and Hongbin Li, who are both very well-known Chinese economists working in Stanford University and UCSD.

> The authors combine their professional expertise as economists with their personal experiences of studying in China to examine the Chinese education system. They show how it both shapes and reflects Chinese society.